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THE

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LETTING OFF STEAM.

THERE was decided in Mr. Justice Bigham's Court last week a case of much interest to steam users, and as it is reported in another part of this issue we purpose devoting a little of our space to commenting upon this action in particular and to technical law cases in general. Naturally one would gladly welcome any new process which would reduce the coal bill, provided all other things are equal, and when an inventor comes forward claiming to evaporate some 75 per cent. more water per pound of coal than is effected in every day practice, and produce a horse-power-hour with less than half the coal we are at present compelled to consume, the prospect is an alluring one to company promoters.

The mysterious Guittari concoction which since 1896 has been threatening to revolutionise present steam practice is described in Specification No. 5,393 of the above-mentioned year, and briefly the process is as follows:—

"The invention has for its object to lessen the consumption of fuel in the generation of motive power by the employment in the boiler of water impregnated with a compound of carbonic acid gas, whereby the generation of pressure is rendered possible with an expenditure of heat energy very much below that by which it would be possible to generate steam in the ordinary way. The use of carbonic acid gas alone for this purpose would not, however, be practicable, as the gas would be quickly driven off from the water on the application of heat, with the result that the gas would become lost and the water be left in its natural condition. The invention consists essentially in the addition to the water of a compound resulting from the combination of carbonic acid gas and a re-agent, whereby the separate evolution of the carbonic acid gas is prevented, and the condensation of the combined gases and vapours after doing work is rendered possible without loss. This re-agent is ethene chloride, commonly known by the name of Dutch liquid." The impregnated water is then supplied to the boiler, the steam generated is used in an engine, passed through a surface condenser, and the ejected liquid used over and over again.

We regret that we are not at liberty to publish the plaintiffs' report *in extenso*, but we may state that the plant on which the tests, referred to in the lawsuit, were carried out consisted of a 10 H.P. nom. Colchester horizontal compound engine with surface condenser. High pressure cylinder 6 inches diameter, low pressure cylinder 10½ inches diameter × 14 inches stroke; fly-wheel 5 feet diameter and 8 inches wide, with water space under rim; speed, 155 revolutions per minute.

Two locomotive multitubular boilers, each with 38 tubes 6 feet 4 inches long × 2¼ inches diameter; heating surface, 164 square feet, each boiler with grate area of 5½ square feet.

The fire-boxes of both these boilers had, however, been bricked up so that the grate area was approximately 2 feet × 1 foot 6 inches = 3 square feet in each. One was charged with plain water, the other with Guittari's patent mixture.

During the progress of the trial before Mr. Justice Bigham, the report of the syndicate's consulting engineer was handed to one of the witnesses, the data of which contained two items of the utmost significance. One was that 16·3 lbs. of Guittari mixture had been evaporated per pound of coal; the other that 1·4 lbs. of coal produced a brake H.P.-hour. The tests of the plaintiffs, however, with Guittari stoking, gave 9·7 lbs. of water and 3 lbs. of coal! How are these descrepancies to be explained away; especially when we are assured that tests made by another well-known engineer, previous to those of the plaintiffs, and who was called on their behalf, gave substantially the same results as theirs! It is a well-known fact that if every heat unit in the coal could have been given to the water, 16·3 lbs. could not possibly have been turned into steam, and when we consider that not more than 70 per cent. of the heat was utilisable for that purpose, the figure obtained by the plaintiffs seems to be a reasonable one. Moreover, when questioned by his Lordship, this gentleman stated that he could not say whether the process was worth anything or not.

Guittari himself, a skilled stoker of the Italian Navy, it is said, could doubtless have thrown some light on the matter, but at the critical moment he was *non est*, and so the secret of the marvellous properties of his invention was left untold.

His Lordship, in his masterly summing-up, gave a brief extract from a report made by the plaintiffs in 1896 for a Mr. Belcher, but had he read a little further he would have noticed the plaintiffs concluded that although in the plant submitted to them at that time (a very small vertical boiler, which Guittari stoked, and an engine which developed between one and two H.P.) the patent liquid seemed superior to plain water, yet the results fell far below that of good steam practice with plant of moderate capacity. Still, the learned judge dismissed this point, and rightly so, as having no real bearing on the case at issue.

One factor which had a very important bearing on the result, was the correspondence between the parties previous to the experiments, the plaintiffs insisting on having a free hand and entirely repudiating the suggested methods of operation put forward by the defendants.

The tests were carried out with about equal brake loads upon the engine, and with equal grate surfaces for each experiment, but even without the plain water test the Guittari result of 3 lbs. of coal per H.P.-hour, with an evaporation of about 9¾ lbs. of water or mixture, was sufficient to prove the mixture to have no advantages, and on this the learned judge spoke very strongly and to the point. Even had an advantage been shown for the mixture, of what value can a process be which must be stoked by the inventor? There is but one Guittari, but there be many boilers.

One of the points in dispute was with reference to the use of an assisted draught, and in addressing the jury, the defendants' counsel laid very great stress upon this point.

Counsel did not apparently secure a full grasp of the purport of the assisted draught, which no doubt would be that it enabled a more rapid combustion to be secured. Instead, he grasped the idea that more air could thereby be put through the furnace, and went on to say that the more air that could be put through the furnace the better would be the results obtained; that air was equivalent to so much fuel, and saved the employ of so much coal, and therefore by multiplying the indraught of air the boiler power was so much multiplied. It was equivalent, said the learned gentleman, to a grate and half, but by what occult method of calculation he arrived at this result we know not. There was not the slightest allusion to the air giving power to burn so much more coal. The argument was perfectly clear and distinct that it was as a fuel the air or oxygen must be considered. We confess we were astonished. We had not thought it possible that so elementary a fact could have been so misunderstood, or that such an entire absence of technical knowledge existed anywhere among a body of men at the English Bar, including, as it does, so many men of really scientific attainments. Such an argument by a ready speaker put in a plausible manner before some juries composed of men of the same unfamilarity with the most elementary science of every-day life might work the gravest injustice if the case really turned on the point.

Fortunately in the case at issue the result did not depend on this, and the learned judge did not think it necessary to allude to it except in a very brief way, but evidently he was fully cognisant of the fallacy, and could have corrected the error had it been necessary so to do. It is often an extremely difficult matter to put facts in a manner that a jury will comprehend, and it becomes the more so when cross-examining counsel put questions that cannot be answered, which have not in them the scientific basis on which to build a reply.

Questions are sometimes quite irrelevant, and often absurd. We think non-technical counsel ought to avoid such cases as involve technical details, and we are a little doubtful as to whether jurymen ought not to be selected to some extent by their qualifications in technical cases.

An Interesting Experiment.—Mr Henry N. Warren, writing in the *Chemical News*, Vol. lxxvi., p. 200, claims "the production of electrical energy by the direct action of the atmosphere." The experiment by means of which he demonstrates this may be described as follows:—Plates are prepared of a special porous compressed graphite, and about one-quarter of each plate is rendered active by immersion in platinic oxalate, drying and igniting in an atmosphere of hydrogen. In contact with a solution of ferrous sulphate, the platinum surface induces oxidation of the iron by the oxygen of the atmosphere. Several of these plates are attached to a circular lead beam, which surrounds a porous diaphragm containing as negative element a rod of amalgamated zinc, the carbons being so arranged as to allow the platinised portion to project above the solution, which consists of strongly acidified ferric sulphate. On completion of the circuit, a powerful current is at once generated, and continues until the complete reduction of the ferric salt has taken place, which naturally terminates the action. On now withdrawing the zinc, the platinum surface condensing the atmospheric oxygen steadily re-oxidises the ferrous salt, and thus renews the action when required.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

Probably the most important point raised by Mr. Gibbings in his Presidential Address was that relating to the standardising of plant, and the remarks made were singularly opportune, because they paved the way for Mr. Wordingham's paper on the "Uniformity of Plant." As the President pertinently remarked: "In the first place each manufacturer has his own particular type and sizes of plant and apparatus; each consulting engineer has his own ideas of speeds, periodicities, and systems of supply, and each borough electrical engineer has probably more 'fads' than all the rest put together." This is a frank avowal of the difficulties that have hitherto retarded the adoption of a system of standardisation, and certainly bespeaks a desire to remove some of the obstacles that have formerly stood in the way. No doubt much difference of opinion exists on many of the topics raised by Mr. Gibbings, and the following paragraph taken from the address sets forth one of the most debatable subjects in municipal supply:—

"My own opinion is, as regards the supply of electricity, that at present there is only one wise course for us to pursue. We are bound to act in the interests of our clients rather than to subserve the interest of the public generally. Only in that way shall we enlarge the constituency of our customers and thus be moving in the direction of a cheaper supply. In a certain city, which owns the gasworks, it has long been the practice to supply all the gas for the public lighting of the streets without making any charge whatever upon the rates. The whole cost has, in fact, been treated as if it were part and parcel of the costs of production for private consumption, thereby, of course, raising the price per 1,000 cubic feet charged to private consumers. Street lighting is undoubtedly a public necessity and a general boon, but the gas consumer alone in this instance is mulcted in the expense. I do not know that any great injustice arises, however, for the gas consumers are almost co-extensive with the ratepayers. But I should certainly deprecate any attempt at present to supply electricity for street lighting purposes on the same basis. It would practically mean burdening a comparatively few, that is, the consumers of electricity for the advantage of all. The entire cost of the public lighting, including the capital cost of erecting lamp pillars, represents no inconsiderable sum of money, and the burden would simply be intolerable. In addition to this it would not be, as I have already stated, a sound commercial policy."

The foregoing is by no means the only important point raised in the address, and, however opinions may be divided on Mr. Gibbings's method of dealing with the difficulties, there can be only one opinion as to the practical and able manner in which the whole field of municipal electric supply is surveyed.

Our record of last week's proceedings practically ended on Wednesday night, which were terminated by the annual dinner, held at the Holborn Restaurant. On Thursday morning the members assembled to discuss a paper on "Uniformity of Plant," by Mr. C. H. Wordingham; "Appropriation of Profits and Repayment of Loans," by Bailie Wm. Maclay, and "Single *v.* Multiple Generating Stations," by Mr. J. F. C. Snell. Following the admirable practice of former meetings, the papers were generally either taken as read or the principal features of the paper were referred to. The first paper of the day, Mr. Wordingham's, is referred to at some length in another part of this issue, but it may be interesting to record some of the principal points of the discussion. At the outset the President made an interesting announcement to the effect that a joint committee of the Municipal Electrical Association and the Institution of Electrical Engineers had been formed to consider the subject of standardising plant. Mr. Dawbarn, of the Brush Company, was first invited to contribute to the debate, and expressed his gratification as a manufacturer that the subject had been raised. They were prevented at the present time from making for stock, and they could not make provision for the future. It would have a great effect on cost if they could make a large number of machines at the same time. He thought it would be of immense service to manufacturers if they knew that in this matter they had the moral support of the Association. Passing on to another phase of the subject, Mr. Dawbarn said that many stations in this country had been started with small units, but the later practice of using large ones was sound, though at the start they suffered from the disadvantage of being run at an inefficient load. Mr. Chamen (Glasgow) thought that there was a general consensus of opinion as to standards, the question was, how to do it. With regard to the voltage of lamps, he was employing 250-volt lamps in Glasgow. Although this voltage might not be convenient for interior arc lamps, they had to remember that the inclosed arc lamp was rapidly coming in, and he thought it possible for three of these to work on 250-volt circuits. By working at 500 volts (across the outers) it meant practically 50 per cent. difference in what they could do with copper. Capt. Sankey agreed that the standardising of plant was of the greatest importance, and the suggestion proceeding from the Association was excellent. He spoke in favour of a standing committee of the Association to which questions of voltages could be referred. Mr. Robt. Hammond, as a consulting engineer, welcomed the movement most heartily. It was their duty to pay the least amount for good plant, and that can only be arrived at by standardisation. He had been much struck, when visiting the works of the Westinghouse Company in America, to see rows and rows of engines in stock. They had worked up their business by the facility with which they could supply engines from stock. He looked forward to the days when those concerns would be most successful who stocked. The question of pressure was the least part of the subject, but the size of plant ought to be capable of settlement. He expressed his dissent with the division of initial plant into sets; they had not in the past considered sufficiently the question of space. With regard to the periodicity question, what were they going to do with the works at present in existence. Mr. Snell (Sunderland) said, though engineers would like standard practice, they could not get it. Mr. Boot (Tunbridge Wells) referred to the financial difficulties of altering present plant to a standard. Mr. Cottam (Hampstead) raised the question whether they would not stifle progress by saying that they would make everything uniform; had they arrived at the stage when that could be done; local conditions very materially affected the question. Mr. Gibbings said there was a good deal of misconception as to the lines on which they proposed to go; it was impossible to standardise the whole system of plant; they could only attempt to standardise periodicities, horse-powers, and so on. Mr. Wordingham in replying on the whole discussion said he was prepared to admit that they were influenced by individual circumstances. He fully recognised that the question of lamps was a matter for argument, and could only be settled by a thorough discussion. That Association could not deal with the matter, for they constituted only a small section of engineers. Replying to Mr. Hammond's point as to size of plant, he thought that the best way of spending money was by subdividing plant; the periodicity question would be settled because most single-phase alternating current machines would be scrapped within the next 10 years. He did not suggest that they should alter everything, nor did he put forward any hard and fast rules; it was only standardisation in the way of sizes, and on general lines that they could proceed.

The "Appropriation of Profits" was the subject of the next paper, and Bailie Maclay dwelt upon the principal points, more, as he said, with the idea of drawing out discussion. It may be mentioned that the paper which is dealt with in another part of this issue does not agree with putting profits from electricity works to the relief of rates, but to be devoted to the lowering the price of electricity. Mr. Councillor G. Pearson (Bristol) was not slow in responding to the worthy Bailie's challenge, and said at the outset he did not agree with it. He held that those upon whose credit money was raised should have a share in the business. In Bristol they had 50,000 ratepayers, and 1,000 electricity consumers, and not more than 1 ratepayer in 50 had the advantage of electric lighting. If they used the credit of these 50,000 ratepayers for establishing electricity works, they might reasonably ask those who paid for the luxury to pay a little more, and so reduce the taxation. Before going in for public lighting, however, he considered that reductions ought to be made to the consumer. Mr. Higginbottom (Manchester) disagreed with the disposal of profits

set forth in the paper. If ratepayers found money for an undertaking, and a profit was made, they were entitled to receive an amount of that profit; if there was a loss on the undertaking it did not fall upon the consumer but upon the ratepayer. The speaker alluded to the protection accorded to the consumer by the Board of Trade.

Mr. Robert Hammond said one of the most difficult things in accounts was the very great difference that existed between the ultimate disposal of what some called profits and others gross profits. If every chairman of committee had the Act of Parliament in his head they would have accurate account keeping. He did not know till then that it was possible to evade the Act by supplying public lighting for ½d. per unit. He found in the case of Glasgow that they were only contributing 1 per cent. to the sinking fund, whereas in Manchester and Sunderland they had to contribute sufficient to repay the loan in 25 years. Leeds, however, which had applied for a provisional order to acquire the Leeds Electric Lighting Company's works had obtained permission to retain the loan for 40 years. They ought to consider that it was the general ratepayer who had to sanction the loan, and nothing pleased him more than to think that a small profit was going into his pocket. Mr. Barnard (Hull) pointed out that if they applied for a loan for machines they were given 15 years to repay, for mains 20 years, and if together 25 years. Mr. Arthur Wright said he once had the opinion that when they started the supply of electricity they were going to supply electricity to ratepayers. Some corporations got only 25 years to repay the loan, and he thought that ought to be the limit, because if they got 42 years they wanted a bigger depreciation fund. Returns to the ratepayers could be made in two ways, by handing over large sums, or building up a sound business, by lighting streets at cost, laying services and mains all over the town. That was a far sounder way of repaying the general body of ratepayers, than handing over sums of money year by year. Lowering the price did not necessarily increase the deficits, and might, in fact, increase the profits. The chief points of Bailie Maclay's reply were, that he was not there to show a bright and shining example. Things appeared to be different in Glasgow, for there was not a single occasion when they had a deficit; they gave something to the ratepayers, in fact, all they had to spare. They raised their money by issuing stock, and when their term expired they borrowed a fresh loan. He agreed with Mr. Wright on the subject of street lighting, they never thought of giving current for street lighting at less than cost.

The next paper was that of Mr. Snell's on "Single *v.* Multiple Generating Stations," but on account of the lateness of the hour, it was not possible to do more than hear a few opening remarks from Mr. Chamen.

The arrangements for the afternoon included a visit to the new works of Messrs. Willans & Robinson at Rugby, and it may be said without exaggeration that it constituted the most valuable object lesson in standardising that was provided during the Convention. Two special saloon trains were provided for the visitors who travelled to Rugby in almost Royal style. Messrs. Willans & Robinson's works are no doubt among the finest workshops in the country, and the excellence of the methods carried out here merit more attention than we are able to give at the moment.

The last day of the Convention was devoted to discussing Mr. Snell's paper, to which we have already referred, and a series of papers on electric traction. Those of Mr. R. C. Quin (Blackpool) and Mr. J. E. Stewart were taken first, and evoked a fairly long discussion. Mr. Rider brought out one or two good points; he objected to depending upon the tramcars for fly-wheel effect, on the ground that it was impossible to find a town where uniform motion of tramcars could be obtained, the speed and the power of the car were constantly varying. He did not approve of car mile, and he considered ton mile as bad; what they had to compare was the passenger mile. He was in favour of an entirely separate committee for a tramway, and the electricity committee should supply electricity to a tramway committee as to a separate consumer. Alderman Higginbottom, Bailie Maclay, and other speakers, followed, but perhaps their remarks will be more appropriate when we publish the papers.

APPROPRIATION OF PROFITS AND REPAYMENTS OF LOANS.

The paper contributed by Mr. Bailie Wm. Maclay, the Convener of the Electricity Committee of the Glasgow Corporation, deals with two subjects, viz., "The Appropriation of Profits and Repayments of Loans."

With regard to the first, Mr. Maclay points out that the policy of the Glasgow Corporation is not to make profits; and here he raises an issue which forces itself upon the serious consideration of all who are responsible for the conduct of municipal trading undertakings. Without doubt the success of those undertakings is generally judged by the amount that is annually handed over to the General Rate Fund.

With this view the policy of the Glasgow Corporation is in direct conflict. "We recognise," says Bailie Maclay, "the fact that not one of these departments exists to make profits as is the case with a private commercial concern—but that rather it has been called into existence for the benefit of the community as a whole," and in opposition to the principle adopted in Manchester, the Bailie further contends:

"That what has been taken from a . . . . consumer in excess of the cost of production and distribution, should be given back to him at once and directly through the department, in the form of a reduced charge in the immediate future. This meets all the wants of the case, and inflicts a hardship on no one. . . . . We hold," he continues, "that it is a sound policy to place as few restrictions on business as possible, especially in these days of keen competition. We maintain that if any of our commercial departments, originated solely for the good of the people as a whole, is compelled to keep the price of anything above the cost of production and distribution; then . . . . an artificial and arbitrary restriction is placed on the business of that committee."

Those who oppose this principle urge that as no municipal commercial undertaking can be conducted without some risk to the ratepayers, it is only fair that the consumers should, in addition to the actual cost of generation and distribution, provide, as a form of insurance, a margin of profit for the benefit of the general ratepayer. It is he whose credit enables the municipality first to borrow at a low rate of interest, and secondly, to arrange for repayment of the capital account over an extended period. It is he whose veto may operate in restricting extensions, and who must be conciliated as the sleeping partner in the concern by the enjoyment of profits, however moderate.

While fully recognising this principle, the Board of Trade, in framing the provisional orders issued under the Electric Lighting Acts, takes care that the consumer shall not be mulcted in an unreasonable sum.

Section 52 of the model order provides for the payment out of revenue of:—

1. Working expenses, *i.e.*, costs of generation and distribution.
2. Interest on borrowed monies.
3. Instalment of sinking fund.
4. All other expenses not properly chargeable to capital.
5. Reserve fund (which duly invested in Government securities shall at no time exceed 10 per cent. of the aggregate capital expenditure).

The net surplus then remaining must be carried to the credit of the local rate.

Here again, however, the consumer is protected, for it is enacted that if the surplus in any year exceeds 5 per cent. upon the capital expenditure, a reduction must be made in the charge to consumers. On the other hand any deficiency must be payable out of the rates.

So much for the provisions enacted by the Board of Trade. It will be seen that it is taken for granted that the price paid by the consumers should certainly be sufficient to do much more than Bailie Maclay, speaking on behalf of his Glasgow colleagues, suggests. Carried to its logical conclusion, his contention would only call upon the consumer to pay the "sheer" cost of production and distribution, which amounted in Glasgow last year to a trifle under 2d. per unit. An examination of the accounts, however, shows that though the principle enunciated by Glasgow may appear

revolutionary, its method of application by the "cannie Scot" leaves the consumer worse off than he is, say, in Manchester, whose ways the Bailie holds up to reprobation.

To make this clear we set out in the case of Glasgow the sum received from the consumers in the year under review, and we add the figures supplied by Bailie Maclay showing how this sum was disposed of. In doing so we work out the ratios which the sums disposed of bear to the gross sum received.

GLASGOW.

Revenue	£30,000	100·00%
Costs of production and distribution ...	£12,000	40·00%
Depreciation	10,705	35·68%
Interest on capital	4,300	14·33%
Sinking fund	1,466	4·89%
Carried forward	1,527	5·09%
	£29,998	99·99%

Average price charged to consumers, 5·08d. per unit.

It will be seen that while only 4·89 per cent. of the sum contributed by the consumer is set aside for sinking fund, a ridiculously inadequate figure, at any rate as far as the generating plant and mains is concerned, more than one-third of the revenue drawn from him is put aside for depreciation, and finally, in flagrant defiance of the law, £1,527 is carried forward instead of being handed over to the General Rate Fund. Those who differ from the Bailie in his proposition that the profits belong to the consumer will smile at the summary way in which he has excluded him from all participation therein. Bailie Maclay points to Manchester as a typical example of how not to do it. Let us see how the Manchester figures compare with those of Glasgow.

MANCHESTER.

Revenue	£49,744	100·00%
Costs of production and distribution ...	£15 284	30·73%
Depreciation	3,344	6·72%
Interest on capital	7,171	14·42%
Sinking fund	7,133	14·34%
Reserve fund	6,812	13·69%
Handed to City Fund in aid of rates ...	10,000	20·10%
	£49,744	100·00%

Average price charged to consumers, 4·63d. per unit.

If the ratepayer-consumer compares the method adopted by Manchester with that adopted by Glasgow, of disposing of the revenue contributed by him, he will, we think, be disposed to pray for deliverance from his friends.

Possibly, however, it may be urged that Bailie Maclay, in referring to Manchester, used an unhappy illustration, and, apart from it, his main contention has still to be considered, *i.e.*, whether municipal works should exist primarily for the benefit of the consumers or the ratepayers.

Our own view is that the general ratepayer has a right to demand from the consumer some *quid pro quo* for the pledging of his credit. In ordinary commercial transactions a banker, for instance, would not hesitate to demand a substantial commission for guaranteeing a credit, and the general ratepayer whose pledge of the communal property enables the community to borrow at, say, 3 per cent., is surely justified in demanding that those who are thereby benefited shall contribute the same percentage on the investment as if it were made by a company.

If such a principle were not acknowledged, there would surely be a speedy end to municipal trading in this country.

Returning to Bailie Maclay, the Glasgow ratepayer has certainly no cause to complain that the burden put upon the electric light consumer is too light a one; indeed, some Glasgow consumers are puzzled to know why, on an almost identical output, his compeer at Edinburgh gets his electricity fully ½d. per unit cheaper, and why he is not supplied at a cheaper rate than that which Aberdeen can afford on a comparatively insignificant output.

Turning to the second part of Bailie Maclay's paper on "The Repayment of Loans," we find much interesting matter with regard to the rates fixed for the liquidation of the loans in connection with the police, sewer construction, street improvement, water supply and markets; but as similar information is not afforded in the case of the gas and electricity department, we are not able to say whether the rate proposed for future years for the electricity undertaking is an equitable one, though we must repeat our surprise at the lowness of the charge of £1,466 for redemption of a capital of over £140,000.

We venture to suggest that local authorities operating under the Electric Lighting Acts should adopt a uniform rate in respect of the sums set aside annually for the sinking and reserve funds, and as those who are compelled by the Local Government Board to repay their loans in 25 years have to provide annual instalments of about 3 per cent. sinking fund, we suggest this minimum figure as the basis for general adoption.

UNIFORMITY IN PLANT.

Of all the papers set down for reading and discussion at the meetings of the Municipal Electrical Association, the one which is, perhaps, of most general interest is Mr. Wordingham's paper on "The Necessity for Uniformity in Plant and Apparatus" (see page 854), as it deals with a subject which is of considerable importance to the advising engineer and his client, to the engineer who is responsible for the working of the plant, and to the manufacturing engineer who supplies it. We have quite recently, in the editorial columns of our issue of May 27th, dealt with some of the points brought forward by Mr. Wordingham, and after a perusal of the statistics given in his paper, we find that in such matters as frequency of alternating currents and voltage of lamps there is even a greater want of uniformity than we were aware of at the time of writing the article referred to. For instance, in Table A, giving the various pressures declared by 109 central stations, no less than 20 different pressures are found, of which eight are between 100 and 115 volts, and six between 200 and 230 volts; whilst from Table B we learn that 19 different periodicities have apparently been found necessary to satisfy the requirements of 58 alternating current stations. Again, from Table D we learn that in the 51 stations using continuous current there are 38 different sizes of unit, ranging from 10 to 1,500 kilowatts, and that 30 of these are for 200 kilowatts or less; and in the 58 stations using alternating currents there are 56 different sizes, ranging from 20 to 390 kilowatts. When one considers that machines of the same output in kilowatts may be required at different pressures, speeds, and frequencies, there is good reason to agree with the author of the paper when he speaks of the chaotic state of central station practice as regards standardisation.

Having quoted statistics to show the necessity of reform, the author proceeds to make various suggestions as to the standardising of apparatus. Commencing with the declared pressure, which is the most important point, since it affects both generating and receiving apparatus, the author suggests that 100 volts and multiples thereof should be adopted as a standard, as more stations are using these pressures than any other, and as they lend themselves very well to the various uses to which central station supply is applied. There is no doubt that for many reasons this would be a convenient standard, but the tendency of later practice has been rather towards 110 volts and its multiples, and we fancy that many advocates of this latter pressure will be found who will advance the arguments that it is as easy to get incandescent lamps of 110 and 220 volts as those of 100 and 200 volts, that two arc lamps will burn better on a 110-volt circuit, and that it would be a mistake to sacrifice the 10 per cent. higher pressure and 10 per cent. lower current, with the consequent saving in mains for equally good regulation of pressure at the consumers' terminals. With regard to consuming devices, we fully agree with the author of the paper as to the advantages that would be gained by adopting a limited number of standard candle-powers for incandescent and arc lamps, and of standard sizes of motors. The greatest difficulty would be experienced with the motors, as in this case the various requirements as to speed enter into the question, and the manufacturer would derive but little benefit from the fixing of standard outputs in brake horse-power, if these outputs are required at varying speeds. The point which is of most interest to the manufacturer of dynamos and motors is, we should imagine, that the output per revolution should be taken as the basis of any standard-

ising of sizes, as this would enable him to keep to a small number of sizes of machine frame, and it is in this part of the manufacture that the multiplicity of sizes leads to the greatest increase in the cost of production.

The same difficulty occurs in the fixing of a series of sizes of generating plant, since the question of speed comes in in all cases where the engine and dynamo are direct coupled. At the present time there are already signs of a tendency to standardise so far as the output in kilowatts is concerned; but there are two distinct interests that have to be considered in this matter, viz., those of the engine maker and those of the dynamo maker. Now it is well known that the speeds at which engines of equal horse-power will be run by different makers vary very appreciably, and the question, therefore, arises whether the engine makers are to be persuaded to adopt a standard speed for a given horse-power, so that the dynamo makers can standardise the sizes of their machines; or whether, as is the case at present, the dynamo maker is to adapt his dynamo to the speed of the engine to which it is to be coupled, in which case he must be prepared to supply a different machine to go with each type of engine although they all give the same output in kilowatts.

With regard to the sizes of unit to be adopted, we think that in very many stations the mistake has been made of commencing with units of insufficient size; the reason being that more attention has been paid to obtaining such a subdivision of the plant as would give the most economical working during the initial stages of the undertaking than to fixing a size of unit which would suit the probable requirements after a few years' working. Mr. Wordingham seems to suggest six as the minimum number of sets which should be installed for a beginning, but we should prefer to start with a smaller number in any station where the probable ultimate capacity was much greater than the initial capacity; as otherwise the first sets would in a few years' time be found to be too small, and very probably would have to be taken out altogether and replaced by larger units. The statement in the paper that it is preferable to have reserve plant in the shape of machines which can be safely worked at 25 or 33 per cent. beyond their most economical load is one that we quite agree with, and is really only another way of saying that machinery should be employed which gives its most economical results at three-quarter load or thereabouts, a procedure we have advocated in these columns before now.

The question of standardising distributing plant is next dealt with in the paper, and the suggestion made therein, that a certain limited number of standard sizes of cables should be agreed on, is one which should meet with the approval of cable manufacturers; as, notwithstanding the large number of different types and sizes of cable described in their published lists, it is necessary, we understand, in very many cases to make special cables to meet the specifications issued for supply mains.

The whole question of standardising plant is, owing to the many interests involved, a complicated one, and will require a good deal of thrashing out; but we believe that much good would result from a thorough examination of it by a representative committee composed of those who have to use the plant and those who have to make it. We did not know, when we published the article already referred to and invited the attention of our readers to the question of standardisation, that we were so soon to learn that the matter was already under consideration; and we hope that the preliminary steps which have already been taken will lead to the appointment of a thoroughly representative committee, and that their deliberations will result in the adoption of more uniform requirements on the part of the users of electrical plant, as we consider that benefit will result therefrom to all parties, as the cheaper production and quicker delivery which should follow such a movement should still further develop the use of electrical apparatus.

WIRELESS TELEGRAPHY.

It is not surprising to find that the public interest in the Marconi system of wireless telegraphy is rapidly increasing, and demonstrations of a more or less public character are being constantly carried out. Some allusion has been already made to some interesting experiments on this system which were conducted some days ago between the House of Commons and St. Thomas's Hospital. One station was in the small smoking room just off the Terrace at the House of Commons, and the other was fixed in the treasurer's house at St. Thomas's Hospital, at the opposite side of the river Thames.

At the House of Commons end the instruments were placed in the small smoking room alluded to, and a wire was led through the window and attached to a short pole, which was tied to one of the lamp-posts on the Terrace a few feet from the window. At the hospital end the instruments were also under cover in an upper room, and the wire in that case was led from the window down to the top of a lamp-post about 6 feet from the wall of the hospital. We need hardly repeat here the method of sending signals, but we may mention that the time occupied in fixing both installations was under an hour, and immediately after, the Speaker, Sergeant-at-Arms, and other Right Hon. and Hon. gentlemen came into the smoking-room to see the first experiment.

Many messages were sent between the two institutions, and it is necessary to record that the first news of the resolution passed by the House of Commons in connection with the public funeral of the Right Hon. W. E. Gladstone was conveyed wirelessly to St. Thomas's Hospital in the terms of the following message sent by Mr. O'Malley:—"The House of Commons to-day solemly and unanimously resolved that a public funeral be accorded the late William Ewart Gladstone, and a monument be raised to his memory in Westminster Abbey," which was suitably acknowledged from the hospital end of the wireless system. The various messages sent and received were all printed on tape, and afforded every satisfaction to those who witnessed the experiments at either end. Of a more practical nature, however, was a series of experiments which were carried out by the Wireless Telegraph Company on the 3rd inst. before Lord and Lady Kelvin and Lord Tennyson at their Alum Bay station, Isle of Wight. After inspecting the outside of the station, the visitors went into the operating room, where they carefully examined the instruments and witnessed the sending and receiving of several messages. Lord Kelvin sent messages wirelessly to Dr. MacLean, his chief assistant in the physical laboratory of the University of Glasgow, to Sir George Stokes at Cambridge, and to Lord Rayleigh and Mr. W. H. Preece in London.

The message to Sir George Stokes was as follows:—"Stokes, Lensfield Cottage, Cambridge. This is sent commercially paid at Alum Bay for transmission through ether, 1s. to Bournemouth, and thence by postal telegraph, 15d. to Cambridge.—Kelvin."

Lord Tennyson's message was to his nephew at Eton, and was as follows:—"Sending you message by Marconi's ether telegraph, Alum Bay to Bournemouth, paid commercially thence by wire; very sorry not to hear you speak your Thackeray to-morrow.—Tennyson." Lord Kelvin insisted on paying 1s. per message royalty for the use of the Marconi system on all the messages he sent, in this way wishing to show his appreciation of the system, and to illustrate its availability already for commercial use.

With the achievement of these striking results one ought not to wait long before a practical application is made of the wireless telegraph.

CONSULTING ENGINEERS AND PUBLIC COMPANIES.

Writing to the *Engineer*, a correspondent finds fault with our contemporary's commendation of Sir F. Bramwell's action in the case of the Hydraulic Joint Company. He thinks that an engineer ought not to step on one side to tell anything beyond the narrow rut in which promoters wish him to carry out his tests. As we have already said, we do not know that an engineer need particularly concern himself with patent rights of a matter upon whose mechanical merits he may be reporting. We do not like the tone

of the letter; nor do we think the writer has picked his illustrations at all well. He cites a case of an engineer testing an American machine, and reporting favourably upon it in ignorance that there was already a better English machine in the market, and he asks us to judge if the engineer was to blame. This is not a case in point. The man reported favourably on a good American machine. It was used in some special trade apparently, and the engineer could not necessarily be expected to know there were better English machines. But if he had known and was honest he would have informed his employers of the fact. Possibly they knew, but it is equally possible they did not know.

Let us quote a case ourselves. The owners of a patent wanted certain comparative tests. Having got them they objected to pay the fees on the ground that the tests were not conducted on the lines they desired. The particular point of dispute was the employment of the patentee to perform one particular and essential function, both on the new process and on the old. It had already been declared that the new process effected a saving of so much per cent. as compared with the old process.

The testing engineers refused to lend themselves to this, as the results obtained would have been simply equivalent to a record of two performances of one man, conducted in one case to the best of his ability, in the other as he deemed fit. The case went to the Courts, and the verdict was for the engineers, who were practically commended for not allowing themselves to be tied by a promoter's chain.

Most engineers will be familiar with the facilities afforded by promoters' plant for misleading mechanical tests. It is to be regretted that too many engineers satisfy any qualms they may feel by adding some remark inconspicuously in their report which will not appeal to the lay public.

The *Engineer's* correspondent thinks an engineer is an over-scrupulous fool who does not allow himself to be a medium for gulling the public. Why should he care for the public, who will certainly not care for him when he comes to beggary through his honesty? This is all very well. Because the public is a "hass," the engineer is to be free to be a rogue. This is not satisfactory. But out of the 20 millions of the public, there are paradventure 10 righteous men. Is the engineer to assist to defraud the 10 righteous, simply because he has a poor opinion of the 19 and odd millions?

The letter we criticise simply begs the whole question. We have already stated that an engineer must be allowed to judge each case by itself. We would add a further suggestion that, for the guidance of all testing engineers, the various engineering societies should combine to retain the services of some independent man or men to whom, in a difficulty an engineer could go for advice if he has doubts as to the propriety of the course he should take, in any case where he feels a temptation to be, in the words of the *Engineer's* correspondent, "too honest."

A POWERFUL ELECTRO-MAGNET.*

M. SAGNAC exhibited to the Society a new electro-magnet for the production of very intense magnetic fields, constructed from the designs of M. Pierre Weiss. Most electro-magnets now in use are of an old type which has not changed since the time of Ruhmkorff, and notwithstanding their admitted excellence, are inferior to those designed from the now recognised properties of the magnetic circuit.

M. du Bois showed this from theoretical considerations, and verified his conclusions with a powerful annular electro-magnet weighing 270 kg., and absorbing 6·5 horse-power. With this he obtained the most intense field yet reached, a field of 38,000 units. The new instrument shown to the Society gives comparable results, though it is much less cumbrous and costly, weighing only 100 kg. and absorbing 2 horse-power.

The rectangular magnetic circuit is arranged to saturate the poles only. The use of but a small excess of section in the part of the circuit which is distant from the poles effects a notable economy in the ampere turns, because the permeability increases very rapidly below the saturation point.

Ease in adjustment of the pole-pieces is of some importance. The adjustment is made by an arrangement like the back centre of a lathe, so that either pole can be advanced or withdrawn with precision, while the construction is sufficiently strong to prevent any flexure. The rectangle forming the magnetic circuit is suspended horizontally by two strong bolts to an oak frame, leaving the space below the poles available for the other apparatus. The field obtained varies with the form of the pole-pieces. At the common apex of two conical armatures it is infinite, but decreases as the cones are more truncated. With cones truncated so that the small base is 1 cm. in diameter, $H = 30{,}000$ units.† But the true measure of the quality of the instrument is the intensity of the magnetisation of the pole-pieces necessary to produce a given field.

$I = 1{,}630$ is the figure deduced from M. du Bois measurements on his more powerful apparatus. Knowing this, one can calculate the field to be obtained with any cones; for instance, with a space 1 mm. × 2 mm., the apparatus would give 44,000 units. With the aid of M. Weiss's electro-magnet, M. G. Sagnac performed before the Society the experiment by which M. A. Cotton showed the change produced in the wave length of sodium light by a magnetic field. The edge of a yellow sodium flame A, observed against the back-ground of a similar flame B, is seen to be black if the flames are suitably arranged. This is due to the fact that the sodium flame is surrounded by a zone some millimetres thick of non-luminous or slightly luminous gas containing sodium vapour, which absorbs the light of the lines, D_1 D_2. M. Cotton has remarked that this black border, first noticed by Crookes, only appears if the lines, D_1 D_2, in the flame B are very narrow. The border disappears completely if B is a brilliant flame containing much sodium, and giving broad D lines. It can be shown in other ways, that the edge of the flame gives two very narrow absorption lines, D_1 D_2. They are so narrow that the change of period produced in the flame, B, by a magnetic field, destroys the absorption, and causes the black border round the flame, A, to disappear, and to re-appear sharply when the magnetic field is suppressed.

This experiment was described in the *Comptes Rendus* of November 29th, 1897; and with more detail in an article in *Eclairage Electrique* (March 5th, 26th, 1898), where are also given experiments on the reversal of the sodium lines, and on the application of reversed lines to the study of the Zeeman effect.

In the experiment performed before the Society, the observation was made parallel to the field. The very intense field employed makes the experiment easy, but is not really necessary. A field of 1,000 units is sufficient if the flames are suitable. The observation can be made at right angles to the field, and the different behaviour of the vibrations when parallel and perpendicular to the field can be observed with the aid of a nicol. Or the arrangement proposed by M. Kœnig (*Weidemann's Annalen*, December, 1897, suppl.) may be employed for observations normal to the lines of force.

* Translation of a paper read before the Société Française de Physique, May 20th, 1898.

ROYAL SOCIETY CONVERSAZIONE.

THE second conversazione of the Royal Society held on June 8th was not distinguished by anything very remarkable in the number or originality of the electrical exhibits. The new gas Krypton—the latest find of Prof. Ramsay in the residues of the atmosphere—was the great scientific sensation of the evening. Only one part of this gas occurs in 10,000 parts of air, and it was necessary to evaporate about one litre of liquid air in order to find it. The spectrum shows two brilliant lines, one of which is almost coincident with a line in the helium spectrum. The finding of so many new elements recently, in a field so well explored as the atmosphere, is calculated to shake the foundations of our chemical faith.

† Ewing gives $H = 24{,}500$, $B = 43{,}350$ as the highest induction he has obtained, the dimensions of his "isthmus" being 2·66 mm. diameter, 3·5 mm. long.

The Steljes Printing Telegraph Recorder was exhibited by Louis P. Casella. This instrument is operated by the Wheatstone A B C magneto-transmitter, and does not require batteries. The printing lever is raised and held up by the alternating current from the transmitter energising an electro-magnet, and when the circuit is broken it is released and allows the weights to do the printing. About 12 milliamperes are required for the instruments, several of which can be worked from one transmitter over a distance of at least 40 miles. The messages sent are printed simultaneously at the sending and receiving stations, and require no skilled operators. The device for placing all the instruments in circuit, in unison, is an interesting one. It prints with rubber type on a tape.

The automatic telephone switch exhibited by the Direct Telephone Exchange Syndicate appeared to be a remarkably efficient instrument for doing the work of the telephone girl. Exchanges for 1,000 or more subscribers have been worked successfully on this system. Secrecy of conversation and continuous service day and night are some of the obvious advantages of such systems, if they can be successfully carried out.

Mr. Roxby exhibited some remarkably good specimens of photographs in natural colours obtained by a process invented and patented by Dr. Selle. As in Ives's, Vogel's, and similar processes, three negatives, representing the three primary colours, are first obtained. From these negatives (in Selle's process), positives are printed on coloured collodion films and superposed. Collotype printing surfaces, with suitably coloured inks, may also be used when larger quantities are required. These three colour processes are likely, in the future, to play a very important part in the reproduction of works of art.

Mr. Campbell Swinton has considerably improved his cathode lamp since the last conversazione. He has now been able to get a light of an intensity of 100 C.P., 1 watt giving about 1 C P. Mr. Swinton uses alternating currents of about 10,000 volts to excite a tube with two cathode discs which focus the cathode rays on a refractory material. The refractory material becomes brilliantly luminescent. This is a considerable advance upon Ebert's lamp, which never gave much more than 1 C.P., though it was asserted to be enormously more efficient than anything claimed by Mr. Swinton.

Messrs. Watson & Sons exhibited the new induction coil, designed by MM. Wydts and Rochefort, described in the ELECTRICAL REVIEW, 42, p. 165, and criticised recently by Mr. Apps in a paper read before the Röntgen Society (ELEC. REV., Vol. 42, p. 782). The instrument exhibited was said to yield an 8-inch spark. The secondary wire weighed less than 2 lbs., and occupied a narrow central position round the primary wire. The insulation was effected by means of a thickened oil of secret composition.

Lord Blythswood and Mr. E. W. Marchant showed some interesting experiments bearing on electrostatic phenomena in vacuum tubes. In a specially shaped tube the flow and return of the electrified particles of the residual gas was shown to be affected by external bodies suitably placed outside the tube. The diagrams illustrating the variation of potential difference at different distances in tubes with movable electrodes were especially interesting. A peak of maximum E.M.F. has been found to exist at a moderate distance between the electrodes, a rapid falling off taking place, both when the distance is diminished, and when it is increased.

Prof. Callendar's apparatus for electrically recording temperature at a distance was shown at work. Diagrams were shown of temperature curves which had been produced at a distance of a mile from the place of observation.

THE REPORT OF THE PARLIAMENTARY ELECTRICAL ENERGY COMMITTEE.

THE report from the Joint Select Committee of the House of Lords and the House of Commons on Electrical Energy (Generating Stations and Supply) has now been published.

The Committee was appointed in March to consider and report—

1. Whether, notwithstanding the provisions of Section 12 (1) of the Electric Lighting Act, 1882, powers should be given in any cases for acquiring land compulsorily for generating stations; and, if so, under what conditions as respects liability for nuisance, notices to surrounding owners, and otherwise.

2. Whether compulsory powers of acquiring land for generating stations, if proper to be given in any case, should be given where the proposed site is not within the area of supply.

3. Whether, in case of a generating station, however acquired, not being situate within the area of supply, power should be given for the breaking up of streets between the generating station and the boundary of the area of supply.

4. Whether powers should be given in any case for the supply of electrical energy over an area including districts of numerous local authorities, involving plant of exceptional dimensions and high voltage; and, if such powers may properly be given, whether any and what conditions should be imposed—

(*a*) With respect to system and plant, and to the construction and location of generating stations, in view of the powers of purchase conferred upon local authorities by Sections 2 and 3 of the Electric Lighting Act, 1888.

(*b*) With respect to the relations of the promoters to other undertakers and to local authorities within parts of the area.

5. Under what conditions (if any) ought powers to be conferred upon promoters seeking to supply electrical energy to other undertakers and not directly to consumers.

The House of Commons appointed Mr. Ashton, Lord Balcarres, Mr. Kimber, Sir Leonard Lyell, and the House of Lords appointed the Lord Privy Seal (Viscount Cross), Earl Spencer, Viscount Knutsford, Lord Monkswell.

The Committee reported:—That the Committee have met and considered the subjects referred to them, and beg leave to make the following report:—

The Committee have taken evidence from Sir Courtenay Boyle, K.C.B., the Right Honourable the Earl of Morley, the Honourable Chandos Leigh, Q.C., Mr. Preece, C.B., engineer-in-chief and electrician to the Post Office, and from Major Cardew, electrical adviser to the Board of Trade.

Counsel appeared before the Committee on behalf of the following:—

1. Central Electric Supply Company, Limited.
2. Chelsea Electricity Supply Company, Limited.
3. General Power Distributing Company.
4. Midland Electric Corporation for Power Distribution, Limited.
5. House-to-House Electric Light Supply Company, Limited.
6. Kensington and Knightsbridge Electric Lighting Company, Limited.
7. London Electric Supply Corporation, Limited.
8. County of London and Brush Provincial Electric Lighting Company, Limited.
9. Westminster Electric Supply Company, Limited.
10. Corporation of Doncaster.
11. Corporation of Glasgow.
12. Corporation of Huddersfield.
13. Corporation of Ilkeston.
14. Corporation of Lincoln.
15. Corporation of Manchester.
16. Corporation of Nottingham.
17. Corporation of Retford.
18. Corporation of Rotherham.
19. Corporation of Salford.
20. Corporation of Sheffield.
21. Corporation of Wolverhampton.
22. London County Council.

The Corporation of Edinburgh and the Metropolitan Electric Supply Company were represented before the Committee by their Parliamentary agents.

The several Bills now pending in Parliament in which effect is proposed to be given to new developments of the electrical industry, have been brought to the notice of the Committee, but they have not considered them in detail, nor taken any evidence upon them. They have treated them only incidentally, as showing the lines upon which the industry is likely to expand. They have laid down the general principles which they suggest should guide Parliament and the Board of Trade, but whether those principles should in whole or in part be applied, and whether any and what special conditions should be imposed, must, of course, be decided in each individual case, according to its merits.

The Committee have heard all the witnesses tendered by the several parties, and have agreed upon the following answers to the several questions referred to them:—

Question 1.—(*a*) The proved public advantages of electrical energy in the generation of light and power warrant, in their opinion, the granting to undertakers of compulsory powers for acquiring sites for generating stations and lands or easements for pipes and mains therefrom, and other works.

(*b*) Provision should be made for the granting of these powers in the provisional orders of the Board of Trade, subject to confirmation by Parliament. Such provision would facilitate a continuance of the existing practice, according to which more or less uniform conditions under which undertakers are to work are provisionally settled by the Board of Trade. Procedure by private bill should be reserved, as at present, for exceptional cases.

(*c*) Such powers may be given either to local authorities or to incorporated companies, whether the incorporation be by special Act or provisional order or under the Companies' Acts.

(*d*) With respect to liability for nuisance, they are of opinion that where the site for a generating station is acquired under compulsory powers, and is specified in the provisional order or special Act, the undertakers should not be subjected to any further liability than that which, according to Lord Blackburn (*Geddis* v. *Bann Reservoir*, 3

App. Cas. 455),* is imposed by the common law in the case of persons exercising statutory powers and duties. On the other hand, where the site for a generating station is acquired by agreement, they think the undertakers ought to be subject to the liability imposed by the common law.

(*e*) With respect to notices, they think that the existing practice as to notices to the local authorities and also to owners, lessees, and occupiers of lands proposed to be taken should be followed.

With respect to notices in gazettes and newspapers, they do not suggest any amendment of the existing procedure.

The amendment of the Electric Lighting Acts, necessary to empower the Board of Trade to grant compulsory powers, will, they assume, comprise provisions for notices and other matters of procedure, for which precedents are found in the Housing of the Working Classes Act, 1890, and in the Light Railways Act, 1896.

Question 2.—Subject to the above observations, the Committee are of opinion that compulsory powers for the acquisition of land for a generating station, and lands or easements for pipes and mains and other works to the area of supply, may also properly be given where the proposed site is not within the area of supply. The local authorities for the district or districts in which the site is, and the owners, lessees and occupiers, should have the same notices and the same *locus standi* as if that district were the area of supply. Provision also should be made for serving notices to local authorities and owners, &c., of districts or land through whose districts or land mains are to be run from the generating station to the area or areas of supply.

Question 3.—In the case of powers being given for the erection of a generating station outside the area of supply, they think that powers may properly be given for laying the mains in streets leading from the generating station to the boundaries of the area of supply. In such case the local authority liable to maintain these streets should have the same option of themselves breaking up and reinstating the streets at the undertakers' expense as is now given in the provisional orders to local authorities within the area of supply, and should be empowered accordingly.

The Committee are of opinion that while it may be advisable to maintain the veto of local authorities as to the erection of overhead wires, given by Section 14 of the Act of 1882, in respect of other electric wires, it is not advisable that in the case of overhead wires for traction purposes the local authority, other than the London County Council and County Boroughs, should have an absolute veto. While due weight should be given by the Board of Trade to the representations of local authorities, the Committee think that in the case of wires for purposes of traction it would be sufficient to give a *locus standi* to such local authorities.

Questions 4—5.—Where sufficient public advantage is shown, powers may be given for the supply of electrical energy over an area including districts of numerous local authorities, and involving plant of exceptional dimensions and high voltage. The Committee further think that undertakings of this character may properly be authorised on conditions differing in some respects from those imposed by and under the existing Acts.

Among the undertakers referred to in the preceding paragraph will be found undertakers supplying energy chiefly in bulk or wholesale to other undertakers, whether local authorities or companies, whose areas of supply are wholly or partly within the area of such bulk or wholesale supplying company, and who distribute the energy so obtained to consumers.

As to giving compulsory powers of purchase of undertakings to local authorities, the Committee, without questioning the policy of Parliament in having given such powers, observe:—

First.—That when the power of purchase was granted in 1882 and 1888, no such schemes of supplying energy in bulk were contemplated as are now before Parliament.

Secondly.—That when the power of purchase was thus granted, the question then before Parliament was chiefly one of light; whereas the evidence given before the Committee shows that although electric light is at present the predominant feature of the enterprises now before the public and Parliament, the application of electrical energy in the form of power to an infinite variety of other purposes is likely to be in the near future the predominant feature and function of these undertakings.

Thirdly.—It does not appear to them that an undertaking supplying energy in bulk at high voltage and in comparatively few mains is, as a rule, so desirable for the local authority to acquire as a low voltage undertaking with many distributing mains.

The Committee think the provisions of the Electric Lighting Act, 1888, enabling the local authority to purchase an undertaking after a term of years, inapplicable, as a general rule, to the case of an undertaker supplying energy in bulk at high voltage, but there may be special cases where it is desirable that the local authorities should have the right to purchase reserved to them. To meet such cases they suggest that the Board of Trade should have power to insert the purchase clause in the provisional order, if the local authorities concerned can, in the opinion of the Board, show good cause for such a course.

It is to be observed that the exemption from liability to compulsory purchase would not prevent local authorities, either alone or in combination with other local authorities, from applying for powers to purchase, but each case would have to be judged on its merits, and such conditions imposed as might be thought fit.

In cases of the exemption from liability to purchase, it would be specially expedient in the interest of the consumers that some kind of sliding scale, as in the case of gas undertakings, should be imposed.

In connection with this question of purchase under Section 2 of the Act of 1888, evidence has been given to the effect that with a view to secure in London one and the same time for the execution of the powers, the Board of Trade have in some cases imposed upon undertakers a less term than 42 years within which they are liable to be purchased.

The Committee suggest that if the full period of 42 years is not granted, and if a substantially shorter period is imposed by the Board of Trade, the terms of purchase should in each case be reconsidered.

The Committee consider that the provisions of the Electric Lighting Act, 1888, which require the consent of the local authority as a condition precedent to the granting of a provisional order, should be amended. In their opinion, the local authority should be entitled to be heard before the Board of Trade, but should not have, so to speak, a provisional veto, only to be dispensed with in special cases by the Board of Trade.

With respect to conditions, the Committee think it reasonable that where a local authority, or company having power to supply light within a certain area of supply, seeks to obtain compulsorily land for a generating station outside that area, it should not be allowed, except where Parliament or the Board of Trade decide otherwise, to supply from that generating station any area outside the area of supply of such authority or company.

With regard to the powers of purchase conferred by Section 2 of the Act of 1888, they are of opinion that local authorities should be empowered to purchase undertakings partly outside their area of supply on terms agreed upon by the Board of Trade.

Provisional Orders.

The ordinary clause which forbids any connection with the earth, except with the approval of the Board of Trade, and the concurrence of the Postmaster-General, should be inserted in every case.

As to protection of telegraphs and telephones, the clauses now inserted in provisional orders seem to be sufficient in all ordinary cases, and regulations to protect the public can be made by the Board of Trade under Section 6 of the Act of 1882.

The clauses which protect gas and water-pipes have worked satisfactorily, and should be continued; but the Committee would direct attention to the observations of Mr. Preece as regards the difficulty arising from the working of tramways by trolley wires; his suggestion as to a strong "control clause" should be carefully considered.

They are disposed to concur generally with Lord Morley and Sir C. Boyle in thinking that, as compulsory powers are given solely for the benefit of the public, it would be desirable to make some provision against these companies being subject to foreclosure on mortgage, and against their rolling stock and plant being liable to distress.

The Committee have directed the minutes of evidence, together with an appendix, to be laid before your Lordships.

Though not directly connected with the matter of the above report, the following discussion which took place on Tuesday night in the House of Commons is of considerable interest. Our report is taken from the *Times* of Wednesday.

On the order for the second reading of the Electric Lighting Provisional Orders (No. 12) Bill, which is to enable the local authorities of Bermondsey and Marylebone to lay down mains for the supply of electric energy, although it can be done by private enterprise under statutory powers which have been conferred,

Mr. Cripps (Gloucester, Stroud) moved the rejection of the Bill, remarking that the Bill raised some of the most important questions which could possibly be raised in connection with our industrial policy, and there was a principle involved which, if sanctioned by the House, applied not only to electric lighting companies, but to all industrial companies whether for the construction of tramways or the supply of gas and water. He spoke in no sense on behalf of the companies involved. He had no connection with them, and no interest in them whatever. The question was whether a private company authorised by Parliament to carry on an industrial undertaking, and which had admittedly carried out all its obligations to the public, should by means of rate-aided competition be be liable to what was, in substance, expropriation without compensation. This was an insidious and dangerous infringement of the recognised principle of security—that every man should be compensated before his property—particularly property guaranteed under an Act of Parliament—could be attacked or depreciated. There was no precedent for the proposition before the House. Where a private company did its duty with statutory powers, and against which no allegation of mismanagement was made, it was only right and fair that it should be bought out before anything in the nature of rate-aided competition was allowed. The principle applied not only to electricity, but to gas and water undertakings. It has been justified, and properly, from two points of view, that it was the only fair way of treating those who had invested under the guarantee and faith of Parliament, and that, unless the local authority sought to purchase, rate-aided competition was wasteful and wanton extravagance. No private enterprise could, in the long run, hold its own with rate-aided competition, and where once Parliament had sanctioned private enterprise it did not allow it to be unfairly crushed. There was no case here of a company not doing its duty and not fulfilling its obligations. They had the assurance in this case of the local authority that the company was amply and properly fulfilling all its duties within its district. They therefore came back to

*Lord Blackburn's opinion is in these words: "It is now thoroughly well established that no action will lie for doing that which the Legislature has authorised, if it be done without negligence, although it does occasion damage to anyone; but an action does lie for doing that which the Legislature has authorised if it be done negligently. And I think that if by a reasonable exercise of the powers either given by statute to the promoters, or which they have at common law, the damage could be prevented, it is, within this rule, negligence not to make such reasonable use of their powers."

the pure question of principle of whether it was fair, where a company had invested its capital on the security of Parliament that the concession was for 42 years, that the ultimate purchasing authority should be allowed to come in, and, by means of rate-aided competition, to depreciate the company's property or to crush out private enterprise altogether. He moved that the Bill be read a second time this day six months.

Mr. Kimber (Wandsworth) seconded the motion for the rejection of the Bill. Although in the Act of 1888 it was provided that the fact of a private company having received a provisional order should not prevent the Board of Trade from giving another order to a local authority, it was implied that the Department should exercise the power delegated to it upon principles of equity. The Board had the duty, with the power, to see that the recipients of the provisional order performed the duties required, but the Board of Trade misconceived its duty if it deliberately exercised its arbitrary confiscatory power, saying to a local authority "take possession of the undertaking of this successful company, it will enable you to reduce your rates." The Board of Trade was a *quasi*-judicial body and should exercise its powers on principles of justice.

Mr. Stuart (Shoreditch, Hoxton) said the speech of the hon. and learned member who moved the amendment was an argument against the Act of 1888; it was now quite out of date. This was no new raid of an unusual kind. In the Act of 1888 it was distinctly provided that the grant of authority to any undertakers to supply electricity within an area "shall not in any way hinder or restrict the granting of a provisional order to the local authority." There was no more to be said about the matter except that these words were introduced into the Act of Parliament as the result of a prolonged negotiation and after a due consideration of all the circumstances of the case.

Mr. Lafone (Southwark, Bermondsey) supported the provisional order, contending that where a company had neglected to do its duty, the local authority should be enabled to step in and do the work.

Sir A. Forwood (Lancashire, Ormskirk) observed that when the Act was passed with the clause reserving power to the Board of Trade to concur in the granting of licenses, that was regarded by the municipalities as a protection to them from the monopolies which had been created by gas companies in previous years. Feeling they had that protection, they did not oppose the obtaining of provisional orders by private parties. Had it been supposed that by not opposing the provisional orders they were going to hang round the necks of the municipalities a monopoly such as that which had been hung round by the gas companies for years, the corporation of which he was a member would have strenuously opposed the passing of any provisional order which would have had that effect. The various private lighting companies had accepted these orders under the conditions of the Act of Parliament which had been quoted. The shareholders knew perfectly well the risks and conditions under which they entered into the businesses and invested their money, and it would be a mistake at this stage to take away from the Board of Trade or municipalities the powers reserved to them under the Act. The clause in the Act of 1888 was a reasonable protection to the municipalities against monopolies, and an adequate protection against undue pressure on the part of municipalities. He thought these electric lighting systems were likely to be taken up very largely by municipalities. This country was sadly behindhand in the matter of electricity. It was a century (*sic*) behind the United States in this respect. In America they had established enormous central power stations, from which not only did they provide for the lighting of a district, but they generated the power for electric tramways and for small industries. What could be more calculated to improve the condition of the people than to enable a small manufacturer to take into his workshop sufficient electrical power to enable him to produce articles, in competition it might be, with larger undertakings? Electric lighting would soon become like gas and water, a public necessity, and such it ought to be in the hands of the municipality.

Mr. Bartley (Islington, N.) said he was doubtful of the wisdom of local authorities embarking on those undertakings; but there was no doubt that the spirit of the age in London was for local authorities to embark on them. There was no doubt also that words were expressly inserted in the Act of 1888 to prevent companies from securing a monopoly of electric lighting in their various districts, and therefore the companies entered on these enterprises with their eyes open. If London municipalities were to be debarred from entering upon these undertakings, it would be very bad for the Government side of the House.

Mr. Knox (Londonderry) thought the House should have some guidance from the Board of Trade in the matter. There were two cases dealt with in the provisional orders—Bermondsey, in which the company had not performed its duty, and Marylebone, in which the company had provided a good service. The object of the Act of 1888 was to give security to any company which gave a good service, and to protect the public against inefficiency and overcharge. But the Board of Trade had given to the local authority in Marylebone competitive powers with the existing company in an area which was being well served by the company. That appeared to him to be going beyond the Act of 1888. If private capital were deterred by such action of the Board of Trade from entering upon these undertakings it would not in the end be for the good of the community.

Mr. Ritchie (Croydon) said he desired to tell the House the position of the Board of Trade in regard to this matter. Applications for provisional orders were not received by the Board of Trade from the local authorities of Bermondsey and Marylebone alone. In one case the local authority and a private company, and in the other case the local authority and two private companies applied for provisional orders for a second supply of electric lighting in their respective districts. The Board of Trade had to consider, first, whether or not any additional provisional order should be granted; and if the provisional order were to be granted, whether it was to be granted to a private company or to the local authority. He had no hesitation in deciding that it would not meet with the approval of Parliament if the Board of Trade were to reject the application from the Vestry and to give the additional provisional order to another company. The hon. and learned member for Stroud had contended that as long as the existing company was properly discharging its duty no second order should be granted in the locality. The meaning of that was that a monopoly was to be given in each area to the company which first obtained the order. That was not only contrary to the public interest, but absolutely contrary to the direction of Parliament. The Act of 1888 clearly showed the intention of Parliament to be that a second order might be granted in any locality, either to the local authority or to another company. Subsequently to the passing of that Act an inquiry was held by Major Marindin as to the conditions under which provisional electric lighting orders might be granted in the metropolis; and he laid it down distinctly that two companies might be granted an order in each area. Therefore it could hardly be said that a company applying for an order after the Act of 1888, and after this inquiry of 1889, did not do so with its eyes open to the possibility of competition. Hon. members had shown that the competition of a local authority might be keener than that of another company, but the Act of 1888 having expressly provided that a local authority might apply for and be granted an order, it was impossible for the Board of Trade to have adopted any other course in this case than that which they had taken. The Board of Trade had not gone into the merits of the case; that was left to the Committee of the House. If the Board of Trade had refused either of these orders Parliament would have been precluded altogether from considering the applications. His view of Section 1 of the Act of 1888 was that it imposed on the Board of Trade the duty of receiving applications, and, unless there was some strong reason other than those which had been advanced, to grant the order in order that it might come before Parliament. If the House of Commons rejected the Bill on its second reading it would not be in accordance with the traditions of the House or with public policy.

Mr. Bryce (Aberdeen) said that the right hon. gentleman had shown that the Board of Trade had no option but to send these proposals to the House. Further, the House was bound to send them to a Committee, for otherwise the Act of 1888 would in effect be repealed. It seemed to be taken for granted that the present lighting arrangements in Marylebone were quite satisfactory. As a matter of fact he, as a resident, knew that that was far from the case. He hoped that the House would support the Board of Trade.

Mr. Brodrick (Surrey, Guildford) wished to corroborate what had been said by the right hon. gentleman of the electric light supplied by the Marylebone Company. It had been assumed throughout the discussion that the supply was satisfactory. He could assure the House that those who had the light in their rooms had made many complaints. When it was proposed to grant a monopoly for 32 years this should be considered by the House.

The House then divided—

For the amendment	114
Against	198
Majority against	—84

The second reading of the Bill was then formally agreed to.

Mr. Cripps moved that the Bill be referred to a hybrid committee.

Sir W. Harcourt (Monmouthshire, W.) asked why it should be dealt with differently from other Bills. They knew the sort of influences to which the House was exposed in regard to Bills affecting private companies, and the sort of solicitation made on Bills of this description. The hon. and learned member had given no reason why the Bill should be dealt with exceptionally. But probably he thought that in a hybrid committee he would have a better opportunity than he now had of defeating the measure.

Mr. Cripps said that, after the statement of the right hon. gentleman, he would withdraw his motion.

The motion was, by leave, withdrawn.

LONDON COUNTY COUNCIL.

Telephones and Generating Stations.

Mr. McKinnon Wood (chairman of the London County Council) presided on Tuesday afternoon at the County Hall, Spring Gardens, over a conference of members of the Council, and the representatives of Metropolitan local authorities. The conference was called to consider the question of telephones and also the report of the Joint Committee on Generating Stations for Electricity in Bulk.

The Chairman in opening the proceedings expressed the great gratification he felt at the representative character of the gathering, and said he had never known a more representative body of local authorities assembled in that hall before. As they knew, a conference of provincial authorities had already been held, for the Council considered the matter was of national importance. At that gathering he was struck with the unanimity which prevailed, and there seemed to be a feeling, with no dissention whatever, that the telephone service at present was grievously restricted, and that reduced cost and improved efficiency would cause very great development. They also protested very strongly indeed against the claims made to break up the streets and override the authority of the local authorities. With regard to London they had a special grievance, for they had the dearest system of all, and they felt that there was a very wide field for extension in the Metropolis. Now only those engaged in extensive

commercial transactions used it, and it would be a great advantage if it could be used in smaller businesses; therefore, they felt it most desirable that those who represented all the districts in London, should, if possible, unite in placing their views before the committee which was thoroughly investigating the subject. With regard to the other question, that of generating stations for the supply of electricity in bulk, they had a direct interest in that, and he felt that in the near future that interest would be greatly increased. Consequently it was considered expedient to discuss that question also at the conference.

Mr. BEACHCROFT pointed out that it was important that the evidence given before the Joint Committee should be before them to enable them to come to a conclusion.

The CHAIRMAN: I believe the report of the committee has been circulated.

Mr. OGILVIE (Lambeth) in proposing the first resolution, said that the National Telephone Company, having taken the wrong line at first, persisted in sticking to it. It seemed that the Post Office had gone body and soul over to the company, but he thought the telephone was not a thing out of which private companies should make profits. The service was both costly and inefficient. The company had paid large sums in buying up opposition, and the users had to pay for it. He moved:—"That in the opinion of this conference the present telephone service of the London area, as supplied by the National Telephone Company, is both inefficient and and inadequate; that the charges, as compared to those made by the same company in the provinces, are much too high, and that these disadvantages to London are largely due to the abandonment by the Post Office of that principle of competition which was expressly adopted prior to 1892 for the protection of telephone users."

This was carried without discussion.

Mr. JOHN SMITH (St. George's-in-the-East) moved, and Mr. MORTIMER (Rotherhithe) seconded, the following motion:—"That this conference views with alarm the action of the Post Office in using, for the benefit of the National Telephone Company, its special powers as to the breaking up of streets, as instanced in the recent case of the Commissioners of Sewers and the Post Office; and urges the Select Committee on Telephones, which is now sitting at the House of Commons to preserve intact that control over the streets which has hitherto been vested in the municipal authorities.

Mr. DEWEY (Islington) while against any interference with the streets, contended that the local authorities could not give the company permission to break open the streets, inasmuch as the Telephone Company had no statutory powers whatever for the purpose of breaking up streets or laying their mains. At present they were placed in the invidious position of being told that they placed obstacles in the way of the company giving a proper service, but the vestries had no power to give the permission. He knew that local authorities had given consent, which he ventured to say they had no right to give.

Mr. BEGG (Limehouse) said they had allowed the company to lay their mains under their streets for five years, but the public had received no benefit and the company would not get an extension. Their clerk said they had the right to give permission, and he was as good a lawyer as Mr. Dewey.

Mr. BENN (L.C.C.) trusted that one result of the conference would be to band the vestries together to fix a universal charge as rent for their streets. It was a question whether the London County Council could extract a rent, but the vestries, if they combined together, might get a considerable sum.

Mr. BEACHCROFT (L.C.C.) said the motion was of wide application, because the question of the Council's position in regard to the streets of local authorities if the Postmaster-General granted them a license would have to be considered.

After further discussion the motion was carried.

Mr. KIMBER moved a resolution to the effect that considering the great public importance of the telephone, it should be taken over by the Post Office and worked as part of the postal service of the nation. He contended that the only way to get an efficient service was to have it worked under one management.

Mr. RIDLEY (Wandsworth) seconded the motion. It was supported by delegates from Greenwich, Lee, and Clerkenwell.

A discussion took place between Mr. BENN and Mr. KIMBER as to altering the terms of the resolution so as to exclude the words "take over the system," but Mr. KIMBER said he did not believe in confiscation.

Eventually, Mr. BENN proposed the following amendment:—"That in the opinion of this conference, the telephone system is of such general public importance, and calculated to become of such general benefit, that it should no longer remain exclusively in the hands of a trading corporation, but should be worked by the Government as part of the postal service of this country."

This was carried.

A motion of Mr. LYON (Camberwell) respecting the means to be taken to combine for a telephone service was discussed at some length, and having been amended, was carried as follows:—"That in the event of the Government not undertaking the telephone service, it is desirable that the local and central authorities of the London telephone area should at once combine to secure an efficient and cheap municipal telephone service."

It was agreed that the chairman should place the resolution before the Select Committee now sitting.

Mr. BENN said that with regard to the generating stations, it was proposed to erect large generating stations to supply electricity in bulk, and the companies promoting such schemes wished to set aside the provisions of the Electric Light Act of 1888, as regarded area and supervision of the purchase clauses. The general principles embodied in these Bills were being considered by the House of Commons, and unless there was some definite proposal brought forward by the Council and local authorities they would probably be passed. One of the results might be that a local authority on acquiring the electric lighting service within its area might find its supply cut off. He thought the Council, as the central authority, should have the power to purchase the bulk companies.

Mr. E. J. WAKELING (Shoreditch) moved: "That this conference regards it as essential to the interests of London as a whole that the present purchase clause of the Electric Lighting Acts, which applies to defined areas, should also be made to apply to such companies as propose to supply electrical energy in bulk to the whole of London without regard to area."

The following motion was also carried on the motion of Mr. E. HOWES (St. Luke's): "That while preserving intact the rights of the local authorities with regard to electric lighting and energy, in the opinion of this conference it is desirable that the London County Council should be in a position to undertake, if it so determine, and if so requested by the local authorities, the supply of electrical energy in bulk for the convenience of any districts desiring to be so supplied, provided they do not become competitors with the local authorities."

CORRESPONDENCE.

Purification of Sewage Effluent by Electrozone.

After reading the article in your issue of April 29th, entitled "The Purification of Sewage Effluent by Electrozone," it occurs to me that the results of an extended and systematic investigation which I carried out some time since in the same line may be of interest.

The purpose of the experimental work was to determine how much "available chlorine" is produced per ampere-hour under various conditions of current density, solution density, &c., in solutions of sodium chloride, and magnesium chloride, and also in mixtures of the trio.

I enclose a table which fairly summarises the results obtained, and is self-explanatory. It is somewhat startling to have the so-called "experts" you mention find the exceedingly huge production of 1·45 gms. Cl. per litre when, according to Faraday's law, the maximum amount possible could be but 1·32 gms.

My experiments were carried out by electrolysing four litres of solution, containing the amounts of salts indicated in the table. This quantity should be sufficient to give a good indication of what we may expect of the process on a commercial scale, besides determining the conditions under which the "available chlorine" is produced most economically.

In several instances the temperature was kept constant at about 11° C., otherwise it was allowed to rise, due to the C^2 R loss in the electrolyte.

The much better results found under this condition of low temperature pointed out very clearly the necessity of keeping the electrolyte at a low temperature.

M. C. Beebe.

Madison, Wis.

[There is no occasion for publishing Mr. Beebe's table. He does not tell us what kind of electrodes he used, and his laboratory experiences do not seem to be of any particular interest.—EDS. ELEC. REV.]

"Honour to whom Honour is Due."

Within the past week, Mr. James Wimshurst, "the inventor of the famous electrical machine," has been elected a Fellow of the Royal Society. Your article that sought to detract from his claims to that honour, has consequently failed in its main purpose. In your last issue you revert to my former criticism, and you cite various German and French authorities to show how great are the claims of Hr. W. Holtz. I have already admitted the greatness of those claims; indeed, anybody who reads Holtz's admirable papers in *Pog. Ann.* and elsewhere, must always acknowledge him the father of the "influence" machine. But he was only the father. He did not gather into one mechanism the sum of his ideas. This was reserved for Wimshurst. The Wimshurst machine is self-exciting; its polarity is subject to no capricious reversals; it does its work well in all weathers; its discharges can be regulated as to quantity, potential, and rate of interruption; and it is, for some purposes, the best possible exciter for Röentgen-ray tubes. Holtz never made a machine that combined those merits.

It is a curious and significant fact that the most modern

Holtz machines are provided with an auxiliary exciter of the Wimshurst type. This is a very proper arrangement, and indicates the exact relationship that should exist between the honoured inventors themselves.

The letter of Hr. Uppenborn consists of two parts; in the first he cites his own book, in the second he gives us a measure of his judgment. It is always a pity to deny a Teuton the luxury of a grievance. Has Hr. Uppenborn forgotten the wise saying of Karl XII.: "Wenn mancher Mann wüste, was mancher Mann wär, thät mancher Mann manchem Mann manchmal mehr Ehr."

Rollo Appleyard.

June 14th, 1898.

Ring Slotted Armatures.

I should be very much obliged if any person could inform me that when designing a ring slotted armature if the section is calculated as if the slots were solid, or how is it calculated, or what allowance is made for slots?

Also supposing the slots were a quarter of an inch wide, would the air space between armature and fields be one-eighth of an inch on each side of armature, or what proportion of width of slot would the air space on each side be?

Subscriber.

Melbourne.

Section of the drum slotted armature is found by taking the diameter across from bottom of slots to bottom of slots. The air space or clearance should be equal to half the breadth of the teeth; in calculating the reluctance of the air space in a slotted armature, the breadth of the teeth multiplied by their number embraced by the poles will give the area of the air space.

Slots should be same width as breadth of teeth; the air space is regulated by breadth of the teeth, not by width of slot.

In a ring armature the section is taken from bottom of slot to inside of ring.

The tendency of recent designs is to make the slots narrow, numerous, and deep; tooth and slot about equal, and the magnetic density in the air space is run up to 10,000 units or double that of a smooth core.

R. Kennedy.

Prof. Carus-Wilson's Paper.

Will you kindly correct a slip in my letter published last Friday to the effect that, in the two curves which I selected for comparing the results obtained with constant and with variable acceleration, the same final speed held for both.

As a matter of fact the figures which I gave at the Institution erred in the same direction as did those of Mr. Short; but the question at issue is not materially affected thereby, so it is sufficient to just mention it.

There was an obvious slip, also, in the employment of the word "acceleration" instead of the word "speed" (at the foot of the page in your issue of Friday last).

I should like to add that my remarks at the Institution, and in my letter to you last week, were based on the assumption that Prof. Carus-Wilson's paper was intended to deal more particularly with high-speed *railway* motors as we understand the term in this country; *i.e.*, with motors hauling trains of carriages between fixed, starting and stopping points, and at a high rate of speed; such as the Central London, the Waterloo and City, the Liverpool Overhead, and the City and South London Railways.

My remarks as to adhesion were based on the values found to hold in the case of the two latter.

A. M. Taylor.

BUSINESS NOTICES, &c.

Books Received.—"The Calorific Power of Fuels." By Herman Poole, F.C.S. London: Chapman & Hall, Limited. 8s.

"Acetylene Gas and Calcium Carbide." By G. F. Thompson, Lombard Chambers, Bixteth Street, Liverpool. 3s. 6d.

"Duncan's Manual of Tramways, Omnibuses, and Electric Railways," 1898. 3s. 6d. London: T. J. Whiting & Sons, Limited, 7A, South Place, E.C.

"Electricity in Town and Country Houses." By Percy E. Scrutton. Archibald Constable & Co., 2, Whitehall Gardens. 2s. 6d.

Electric Cooking.—Messrs. Crompton & Co., Limited, Arc Works, Chelmsford, have issued a new edition of their catalogue of electrical heating and cooking apparatus. The list, which consists of about 40 pages, describes the various domestic and other apparatus manufactured under the Crompton-Fox patents. It is claimed that, in the method of attaching the utensil or apparatus, the wires are firmly secured in place on an insulating ground work, and completely protected from the action of the atmosphere, and also from mechanical damage, by a coating of a strong vitreous enamel of very high insulating properties, and capable of thoroughly withstanding the heat of the wire itself. The wires which generate the heat can be fixed in very close contact with the article to be heated, thus giving a high efficiency, and the methods by which this is done are the result of over eight years' experience. The list gives prices and particulars of a variety of hot plates, saucepans, fry pans, flat irons, radiators, &c. The prices of certain articles are considerably reduced. Messrs. Crompton also send us a copy of a pamphlet by Mrs. Seaton, giving practical hints on the use of electrical cooking apparatus, and instructions for using electric heating appliances.

Electric Lighting of Tin Plate Works.—Morfa Tin Plate Works, Llanelly, are following in the wake of other works of the same kind in this centre of the Welsh industry by securing an installation of electric light. The contract has been given to Messrs. J. C. Howell, Limited, Llanelly. The work will be commenced shortly.

Electrical Plant for Australia.—The machinery for the lighting of the City of Goulbourn, N.S.W., is being built by Messrs. Johnson & Phillips, of Old Charlton, the order having been handed to them by their sole representative in Australia (Mr. W. W. Crawford, consulting engineer, Imperial Chambers, Sydney, and Brookman's Buildings, Adelaide), who is at present on a visit to London. This firm have also in hand the order for plant for lighting Port Adelaide, South Australia.

The Jandus Arc Lamp.—Messrs. Drake & Gorham inform us that the gold medal was awarded to the "Jandus" arc lamp at the recent Hull Exhibition. The firm also exhibited a selection of their specialities in electric light fittings, which was awarded a silver medal. The same firm also show some good specimens of art metal work at the Exhibition now being held at the Royal Aquarium. Amongst other fittings can be seen French candelabra and sconces of the best designs, and a special feature of the exhibit is an attractive collection of old Dutch fittings and Japanese bronzes adapted for the electric light.

Nernst Incandescent Lamps.—Messrs. Ganz & Co., of Buda-Pesth, have purchased the Austrian, Hungarian, and Italian rights in the Nernst process for the manufacture of incandescent lamps. We believe we are correct in saying that the rights for this country and the Colonies respectively have been purchased by two well-known companies.

New Premises.—Mr. James Morris has opened new premises in Railway Road, Leigh, Lancashire, as an electrician, optician, and photographic dealer.

Messrs. Palmer & Watson, electric light and power engineers, 100, Charing Cross Road, have again to extend their business premises, and they will shortly open a showroom for electrical fittings and appliances on ground floor at the above address.

The Ventnor Electric Light and Power Company have opened premises in High Street, Ventnor, for the supply of electric light fittings, &c.

Messrs. Dobsons & Curtis Bros., Limited, electrical engineers, of Dublin, have opened an office at 74, South Mall, Cork. Mr. L. E. Buckell is in charge of the branch.

Salmony v. Kitching.—In the Hull County Court last week Messrs. H. M. Salmony & Co. sued Mr. C. H. Kitching, electrician, Beverley Road, Hull, for £18 16s. 1d. for goods sold and delivered. Mr. Stamp said that on September 7th the defendant was endeavouring to obtain the agency for Hull and district for the plaintiffs' firm, and saw Mr. Rosenberg, a member of the firm, who was in Hull, and then ordered verbally a quantity of electrical goods. The order was subsequently taken down in writing at the defendant's dictation. Dr. Jackson (for the defendant) explained that 13s. 10d. admitted had been paid into court, and £7 14s. 6d. was paid into the High Court, whence the case had been transmitted. Mr. Stamp, continuing, said that the order was given on September 7th, and the real question in dispute was whether the defendant was entitled to return certain lamps on the ground that they were ordered of the Electrical Company's make, and not so supplied, but someone's else At the time, however, nothing was said as to any lamps whatever. The plaintiffs did not manufacture lamps, and the defendant was endeavouring to obtain the agency for the plaintiffs' firm. The firm whose lamps it was afterwards alleged were sent, were the direct competitors of the plaintiffs' firm, and neither of the firms actually made lamps. They were supplied from Berlin. On the 14th of the same month the defendant wrote complaining that the lamps were very unsatisfactory, and informing the plaintiffs that he was going to send them back as he declined to

receive them. On September 25th plaintiffs sent 716 lamps at 7s., and 72 lamps at 1s. 1d. each in two boxes and a few other goods in a barrel. On October 26th plaintiffs received back an empty barrel, and gave defendant a credit note of 5s., and on October 27th they received two boxes of electrical goods, for which they also gave credit. On November 27th defendant for the first time complained that he had not received proper credit. The plaintiffs now claimed that they had not received 621 lamps which it was alleged were returned, and for them they now claimed £18 2s. 3d. Dr. Jackson contended that there had been no contract made, and that the goods sent were of an inferior quality and were sent back, and at present were in the possession of the plaintiffs' agent. His Honour gave a verdict for the amount claimed, with costs.

Electrical Wares Exported.

Week Ending June 14th, 1897.	£	s.	Week Ending June 14th, 1898.	£	s.
Alexandria	20	0	Adelaide	137	0
Amsterdam	260	0	Amsterdam	130	0
„ Teleg. cable	39	0	Auckland	293	0
Antwerp	22	0	Balia	614	0
Archangel	19	0	Bombay...	52	0
Auckland	159	0	Boulogne	122	0
Barcelona. Teleg. wire	53	0	Buenos Ayres	189	0
Bombay...	1,286	0	Calcutta...	119	0
Boulogne	12	0	Cape Town	2,784	0
Brussels...	2,229	0	Copenhagen	11	0
Buenos Ayres	50	0	Durban	26	0
Calcutta	742	0	East London	123	0
Canterbury	84	0	Fremantle	2,794	0
Cape Town	217	0	Hong Kong	85	0
Colombo	74	0	Monte Video	81	0
Constantinople... ...	80	0	Nagasaki	690	0
Copenhagen	8	0	Nelson	12	0
Delagoa Bay	255	0	Ostend	85	0
Durban	242	0	Penang. Teleg. mat. ...	400	0
Fremantle	3,733	0	Port Chalmers	442	0
Gibraltar	1,330	0	„ Elizabeth	350	0
Hamburg	180	0	Rio Janeiro	1,154	0
Havana	156	0	Rotterdam	248	0
Madras. Teleg. mat. ...	65	0	Saigon	16	0
Marseilles	125	0	Santos	337	0
Melbourne. Teleg. mat.	53	0	Singapore	54	0
Monte Video	25	0	Stockholm	161	0
New York	100	0	Sydney	725	0
Penang. Teleg. mat. ...	95	0	Tantave...	33	0
Port Said	26	0	Valparaiso	48	0
Quebec	480	0	Wellington	40	0
Rangoon	15	0			
Rio Janeiro	43	0			
„ Teleg. mat.	4,607	0			
Shanghai. Telephone...	82	0			
Singapore	60	0			
Stockholm	120	0			
Suez	21	0			
Sydney	621	0			
Wellington	30	0			
Total ...	£17,828	0	Total ...	£12,455	0

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court held last Friday, Wm. Retallack was allowed to pass his public examination upon accounts showing debts £568 6s. 10d., and no available assets. In the course of his evidence the bankrupt said he commenced business as a manufacturer of electrical appliances in 1882, at Canonbury Square, N., in partnership with another as "Player & Retallack." In all he had had five partners, but during the latter part of the trading he was the sole proprietor of the business, which was abandoned because the trade had fallen away and could not be continued at a profit. His insolvency was due primarily to loss on the trading. The examination was concluded.

At the Sheffield Bankruptcy Court a few days ago, before the Registrar (Mr. Joseph Binney), John Henry Dewhurst and John Longden, lately carrying on the business of mechanical and electrical engineers and mill furnishers, Attercliffe Road, under the style of John Dewhurst & Son, came up for their public examination. The statement of affairs showed liabilities amounting to £2,143 13s. 9d., and assets estimated to realise £100. Debtors were represented by Mr. J. E. Wing. The examinations were closed.

A meeting of the creditors of James Fletcher and John Arthur Hirst, carrying on business under the title of Messrs. Fletcher, Hirst and Co., electrical and mechanical engineers at Burnley, Chester, and Derby, was held at the offices of Mr. C. J. Dibb, official receiver, in Quay Street, Manchester, on Tuesday last. The liabilities amounted to £2,184, and the assets to £424, a deficiency of £1,760. Debtors were adjudicated bankrupt, and Mr. George Proctor, of 3, Grimshaw Street, Burnley, chartered accountant, was appointed trustee of the estate. A committee of inspection was also appointed.

In the Manchester Bankruptcy Court last Monday, R. C. Douglas formerly carrying on business as an engineering contractor at Bradford, and some time in partnership with others, under the style of "The Manchester Electric Company," at Haworth's Buildings, Cross Street, Manchester, was examined by the Official Receiver. His statement of affairs showed a surplus of assets over liabilities of £1,036, and he attributed his failure to inability to obtain payment of amounts which he claimed from certain persons. The examination was adjourned.

Auction Sales.—On June 20th and 21st, Messrs. Robins, Snell & Gore will sell by auction, at 219A, Oxford Street, W., the entire stock of an electrical contractor, including accumulators, switches, arc lamps, motors, cycle lamps, &c. See our "Official Notices" this week for further details.

Messrs. Percy Huddleston & Co., will sell by auction at 11, Long Millgate, Manchester, on June 30th, a quantity of electrical apparatus, &c., for particulars of which see our "Official Notices" this week. The list includes dynamos, motors, 10,000 switches and fittings, cables, and wires, &c.

Change of Address.—The offices of the Brockie-Pell Arc Lamp, Limited, have now been removed from 97, Queen Victoria Street, E.C., to 21, 23 and 25, Tabernacle Street, E.C.

Lists.—Messrs. Crompton & Co. are circulating a price list of enclosed long-burning arc lamps.

The Davy Electrical Construction Company, Limited, of Highbury, send us a number of lists illustrating and describing their types A, B, and C enclosed arc lamp.

Messrs. Beanland, Perkin & Co., of Leeds, have issued a list of electric air propellers, table ventilators, and small motors.

The Langdon-Davies Electric Motor Company, Limited, have issued a new list of their alternate current motors. A catalogue will be brought out in a few weeks.

Messrs. Foxcroft & Duncan, of 24, Queen's Road, Dalston, N.E., send us a set of lists of their various manufactures, including gravity and dead-beat voltmeters and ammeters, permanent magnet ditto, Cardew voltmeters, "Phœnix" and "S.S." arc lamps, hatchet switches, resistances and choking coils, &c. The firm make all the measuring instruments as formerly manufactured by Messrs. Paterson and Cooper, of Dalston, including the Ayrton and Perry commutator and non-commutator instruments. The gravity instrument mentioned above has been only lately introduced.

Smoke Nuisance.—The London Electric Supply Corporation, who were recently fined for a smoke nuisance, have given notice of appeal to the Greenwich Board of Works. Two more cases of nuisances having been reported, the Board have decided to proceed against the parties concerned.

ELECTRIC LIGHTING NOTES.

Barmouth.—On 7th inst. the District Council held a special meeting to consider the question of lighting the town by electricity. A proposal was put forward by Mr. Dd. Davies, of Beach Road, who offered to destroy the refuse for 5s. a day, and put down an electricity works, the wires to be laid underground, the work to be completed in 18 months, and a guarantee to be given to supply electric light for five years on terms to be agreed upon. The Council agreed to support Mr. Davies's scheme, and he is to submit plans.

Barnsley.—Mr. Miller, electrical engineer, has been instructed by the Council to prepare plans, estimates, &c., for an electric lighting scheme. Application is to be made to the Local Government Board for a £23,322 loan. It was stated last week at the Council meeting that there was such a large demand for electrical materials that it might be 18 months before the scheme would be completed.

Barrow.—The Electric Lighting Committee has appointed a sub-committee to superintend the erection of buildings and the carrying out of works in connection with the electric lighting undertaking. The sub-committee will negotiate for sites for the erection of sub-stations. The electrical engineer has been authorised to engage the necessary staff for breaking up the streets to lay mains. Before the mains are laid, the Highways and Lighting Committee are to be asked whether they contemplate street lighting by arc lamps. It is expected that current will be available by the end of October.

Belfast.—The engineer last week reported the progress of the works at the new electricity station, and the successful testing of the first and second boilers. It was decided to advertise for a fully qualified man to act as engineer-in-charge.

Bethnal Green.—In regard to our last week's paragraph under this heading, Messrs. Calvert & Co., electrical engineers, 4, St. Mary's Street, Manchester, write calling attention to a slight inaccuracy in the report. They say:—"The Board of Guardians accepted a tender of ours apparently without reading it, and then requested us to sign a contract containing a clause 'in accordance with the specification and plans prepared by the engineers but *not* in accordance with the said tender.' We offered, we did not *demand*, as the original tender was the one accepted—an addition at which we would be willing to sign the draft contract with the inclusion of a minor protectionary clause. This offer, as you know, was not accepted. We have been asked to send in a fresh tender, the work being re-advertised."

Birmingham.—At the City Council meeting on Tuesday, the Lord Mayor submitted the recommendation of the General Purposes Committee as to the purchase by the Council of the undertaking of the Birmingham Electric Supply Company, Limited, at the price of £420,000, and authorising the committee to take the necessary steps for the promotion of a Bill in Parliament to authorise the purchase. The recommendation of the committee was that they should pay £10 10s. per share for the £5 shares of the company, and

take over the undertaking as a going concern, with all its assets and liabilities, as from January 1st, 1898. There was no opposition to the scheme, and the recommendation of the committee was agreed to. The voting was 53 for, 0 against, and 5 neutral.

Blackpool.—At a meeting of the Town Council on Tuesday last week, Councillor Brodie, as chairman of the Electric Lighting Committee, presented a statement as to the working of the department during the past financial year. This showed that the working of the tramways had realised a gross profit of £5,290, and after paying £2,984 for interest on capital and sinking fund, there was a net profit of £2,306 on the working, as against £230 in the preceding 12 months. The gross profits in the electric lighting department were £5,675, and with £3,856 placed to sinking fund and interest on capital, there was left a net profit of £18,190. Councillor Brodie said some complaint had been made on the ground that the Committee were making a profit, and demands put forward for a reduction in price. He referred the Council to what occurred two years ago, when the whole of the cables failed involving an unexpected expenditure of £13,700. Had there not been a suspense account the ratepayers would have been taxed very heavily to repay that amount; and the Council were determined that until this suspense account was put right again the users of electricity should not have the benefit of any reduction. He added that it was proposed to spend a sum of £40,000 in extensions. The statement was adopted. At the same meeting the salary of Mr. R. C. Quin, the electrical engineer, was advanced from £300 to £400 per annum.

In response to a requisition signed by a large number of ratepayers, the Mayor of Blackpool has convened a public meeting for the purpose of considering the proposal on the part of the Town Council to borrow a further sum of £40,000 for extensions in connection with the electric lighting scheme. The petitioners to the requisition assert that the ratepayers generally desire fuller information as to the expenditure by this department of the Corporation since the inauguration of the works. The undertaking was commenced five years ago with a capital of £26,000, but in subsequent years other sums, amounting to £54,000 were expended, so that if the present application for £40,000 is granted the capital will be raised to £120,000. Upon this large expenditure, and also in regard to the overhead system, many of the ratepayers apparently hold strong opinions.

Bray.—The Township Commissioners have decided to reduce the price of electric current from 6d. to 3½d. per unit after one-and-a-half hours' lighting of maximum demand.

Bridgwater.—The Somerset Drainage Commissioners will oppose the electric lighting Bill for Bridgwater when it is heard.

Burslem.—Last year when the Council passed its resolution applying for a provisional electric lighting order, it was too late for anything to be done. A second resolution has now been passed, and the application will go forward.

Burton-on-Trent.—We understand that, in addition to a large sum voted for gas extensions, £11,000 is to be spent upon electric lighting extensions.

Buxton.—Prof. Kennedy's plans, &c., of an electricity undertaking are before the Council, which has held a special meeting to consider them.

Camberley.—Mr. Lucas, of Bournemouth, is anxious to carry out the electric lighting of this district at a cost of £25,000 or £26,000, and last week he met the District Council and explained in outline his proposals. During the last three years Mr. Lucas is said to have expended £40,000 in the locality, and is to build a number of additional houses shortly. The scheme would extend from the schools to the Jolly Farmer, and would extend over the whole of the Frimley district, but he would not proceed with it if the Council would oppose his application for the order. The Council will meet Mr. Lucas again in committee.

Canterbury.—The Council has adopted the recommendation of the Lighting Committee that the sum mentioned by the contractors for connecting up to consumers' houses for 30s. per house be accepted, and that the charges for current be as follows:—Private lighting, 6d. per unit; power and heat, &c., 3d. per unit.

Chelsea.—The Chelsea Electricity Supply Company, Limited, announce that they have reduced their price for power and heating, supplied at 200 volts, to 3d. per unit.

Cheltenham.—At last week's Council meeting the Lighting Committee reported that the electrical engineer had submitted estimates of the costs of providing arc lamps for lighting the Gloucester Road from the High Street to the Lansdown Castle, and the Tewkesbury Road from the Gloucester Road to the High Street Railway Station. Three schemes were submitted, and he recommended the third, involving an expenditure of £3,855, viz., Gloucester Road, Tewkesbury Road, and Lansdown Road (from Lansdown Castle to Westal Green), 15 arcs on arches in Lansdown Road, 37 on side pillars in Gloucester Road and Tewkesbury Road, and one on a centre pillar at the Lansdown Castle. The estimate assumed that the arc lighting cables along Lansdown Road are laid at the same time as the private supply cables for this road. If these cables were not laid as described the extra cost would be about £80. The acceptance of this scheme would necessitate application for an additional loan of £875 beyond that last applied for and not yet granted. The Lighting Committee approved the report and advised the Council to authorise the electrical engineer to arrange to carry out scheme 3, and also recommended that the private lighting mains in Lansdown Road be laid at the same time as the main for street lighting, that the Local Government Board be asked to sanction an increase of the loan for which application to borrow is now pending by the sum of £875, and that the electrical engineer be authorised to order switch gear required for the arc lighting circuits in Manchester Street. After a brief discussion the Council approved of the various recommendations.

Clacton-on-Sea.—The Sea Wall Commissioners considered the question of lighting the front last week, and there was a feeling in favour of electric lighting.

Coventry.—Mr. G. W. Willcocks held a Local Government Board inquiry on Tuesday, with respect to the application of the Corporation to borrow £30,000 for the extension of their electric lighting system. The Town Clerk (Mr. L. Beard) said the electric light works were opened for public supply on January 1st, 1896, upon a comparatively small scale. An extension was soon necessary and the plant had been increased to 350 kilowatts, and the mains to 3½ miles. The capital outlay was £33,000. The Electric Light Committee had adopted the recommendations of their consulting engineer (Mr. R. Hammond), for a large extension of mains, additions to plant, provision for street lighting, and a railway siding. The estimated cost was £33,000. After detailed evidence by Mr. Hammond, the inspector visited the works and the sub-stations.

Darlaston.—The Midland Electric Corporation for Power Distribution, Limited, has entered into a satisfactory agreement with the Council.

Douglas.—Prof. Fleming's report on the scheme of the Town Council for the lighting of Douglas has been received, and will shortly be issued. His estimate of the cost of the smaller scheme submitted, namely, the lighting of the Promenades, Victoria Street to Finch Road, and Duke, Strand, and Castle Streets, is £30,000. Calculations made on this estimate show that the cost of electricity compared with the present gas system would be £1,000 a year in excess at first. Prof. Fleming has also reported on an extended system.

Dover.—A lady has claimed compensation from the Dover Electricity Supply Company for injuries sustained through falling over an electric light box in High Street. The company has admitted its responsibility.

Ealing.—At the meeting of the Ealing District Council on the 2nd inst., the Electric Lighting Committee reported, says the *Middlesex County Times*, that the question of the conduct of the switchboard men had occupied its attention, and it recommended that Mr. Bush be discharged. Mr. Recano's resignation was received. The committee, with the exception of one member, declined an interview. Mr. Armriding said that that morning he had received an electrical paper, and in an article in it there were some very grave accusations against their chief engineer. As a member of the committee he had never once received any information of any complaint from these men, except that Mr. Jordan handed him a letter from Mr. Knight, and a letter from Mr. Bush. Had he known of these accusations he would certainly have supported Mr. Brampton's proposal that Mr. Recano should be heard. After some discussion, Mr. Taylor moved that a special committee should meet at the earliest possible moment. Mr. Brampton seconded, and said he should like it to be composed of the whole Council, as it was no good referring it back to the Electric Lighting Committee. The chairman: This particular subject has not come before them. Mr. Thayers moved as an amendment that the Electric Lighting Committee be the committee to take the subject into consideration. Mr. Armriding seconded. Mr. Cowley said he was rather inclined to vote with Mr. Taylor, though out of no disrespect to the Electric Lighting Committee. He thought it more satisfactory, considering the circumstances, and to avoid it being said afterwards that they wanted to carry out their own ruling. Mr. Norris said that he was afraid if the matter did not go to the Electric Lighting Committee, it might perhaps look like a little snub to them. The committee had perhaps been a little partisan, but he had every confidence in its justice and he felt sure it would give the other side a fair hearing. Mr. Jordan said that the evidence they had had before the Electric Lighting Committee was very serious, and it would lead to more serious consequences in the future. They had done their duty in taking the action they had done. The whole Council had sufficient confidence in Mr. Knight to make him the head man at the place, and it was the duty of an employer to place every confidence in his manager until he found him out. The amendment that the matter should go before the Electric Lighting Committee was then put and carried by six votes to three.

It is stated that the Electric Lighting Committee last week made an exhaustive inquiry regarding the allegations. On Tuesday last week the committee examined all the employés at the works, and on 10th inst. sat again for the purpose of formulating its report to the Council, which was to be presented this week.

Eastbourne.—The Town Council last week adopted minutes of the joint sub-committee, in which they reported that "they considered the reference from the Council as to authorising them, if they thought proper, to engage Mr. Wright, of Brighton, electrical engineer, in addition to or in substitution for Mr. Hawtayne. It was resolved that Mr. Hawtayne be engaged to report on the proposal that the Corporation should provide the necessary plant, &c., for generating electric light for the existing public lamps and public buildings, either separately or in conjunction with the refuse destructor, for a fee of 30 guineas, without binding the Corporation to engage him in the event of their deciding to undertake any of those

works. Further, that the question of engaging Mr. Wright be postponed for the present, pending the receipt by the committee of Mr. Hawtayne's report."

Edmonton.—In connection with the proposed installation of electric light in the workhouse, Mr. Sydney J. Ross has written offering to act as consulting electrical engineer for the scheme submitted by him, which amounted to £2,500. The letter was referred to the Works Committee of the Guardians.

Erith.—The Erith District Council have engaged the services of an expert on the matter of electric lighting.

Flitwick.—Mr. Alfred Pearse, the well-known illustrator to London magazines, has entered into partnership with Mr. Snetzler, engineer. They have purchased a factory in London. One of Mr. Pearse's smaller schemes is to light up the little village of Flitwick, where Mr. Pearse has a country residence, with electric light by means of the river Flit. At the place where it is proposed to erect the motor, the river is 15 feet wide, and is capable of supplying 20 H.P.

Folkestone.—Last week Colonel Coke, R.E., held a Local Government Board inquiry in respect of an application made by the Town Council to borrow the sum of £1,200 for the purposes of electric light—namely, the purchase of standards. The town clerk explained the purposes for which the money was required. There were, he said, to be 40 standards along the Leas front. The Council had accepted a tender at the price of £15 14s. per standard for those on the Leas, and £14 for the streets, and in addition there would be an allowance for fixing and painting—£2 each.

Frimley.—At the last District Council meeting, Mr. Lucas attended and addressed the Council *re* electric lighting. He asked the Council whether they would support him when he applied for the provisional order, or whether they intended to carry out a scheme of electric lighting themselves. The outlay on the whole scheme would be something like £25,000 or £26,000. After consideration it was decided that Mr. Lucas, with his engineer, should meet the whole Council in committee and go through the scheme.

Garston.—At the last District Council meeting a letter was read from the Local Government Board, enclosing a copy of a letter sent to themlby Messrs. Peacock, Gregory & Bousfield, solicitors, Liverpool, asking them not to sanction the application of the Garston District Council for power to borrow £24,000 for the purpose of erecting a refuse destructor and electric lighting station at Grassendale; also petition signed by 542 owners objecting to the refuse destructor and electric light generating station being fixed there. The central authority asked for the opinion of the Council on these matters. After some discussion the Special Purposes Committee was instructed to prepare a reply.

Germany.—Messrs. Siemens & Halske, Berlin, have just secured a contract for the establishment of a central electric lighting station at Ahlfeld-am-Leine at a cost of £65,000.

Glasgow.—The Watching and Lighting Committee advises that in the event of the Corporation deciding to erect trolley poles for the High Street tramways, from Glasgow Cross to Parliamentary Road, such poles should be used for lighting purposes. 37 lights would be required, the annual cost of the electric current, at the present rate, being £666. Gas lighting costs £191 at present.

The Dean of Guild Court last week granted the Glasgow Corporation permission to erect a new generating and electric storage station in Corn Street and Sawmillfield Street.

Godalming.—The authorities at Whitehall have refused to sanction the raising of a loan for the purpose of electric lighting at Godalming, in consequence of the strong opposition laid before the inspector who inquired into the matter.

Hackney.—We learn that the Vestry has referred Mr. F. H. Medhurst's action to a Special Committee, consisting of the Chairman of the Vestry, and the Chairmen of the several Standing Committees, the said Special Committee to have power, in the name of the Vestry, to engage counsel, incur expenditure, and to take all steps that may be deemed expedient to defend the interests of the Vestry in respect of such action. The Vestry last week decided by a good majority not to hand the provisional order over to a company.

Hanley.—The North Staffordshire Traders' Association is agitating for a reduction in the charges for current.

Hampstead.—The Vestry has decided to extend the public lighting by arc lamps from a point near the Hampstead Fire Station along Heath Street to a point close to the summit of the Heath.

The Vestry is to be asked to consider the advisability of lighting West End Lane, Mill Lane, Fortune Green Road, and Fortune Green by electricity.

Huddersfield.—At Wednesday's meeting of the County Borough Council, the electrical engineer reported the number of consumers of electric light for the month to be 685, an increase for the month of 24. The lamps connected—46,014—showed an increase of 1,257, and the units metered in May, 28,460, or an increase on the corresponding period of the previous year of 9,779, equal to 52 per cent. The tender of Mr. James Proctor, of Burnley, for the sum of £69 per boiler, delivered and fixed, for mechanical stokers for the four new boilers at the electric supply station, was accepted. The tender of Messrs. Read, Holliday & Sons has been accepted for the electric fittings for the new police station at Huddersfield.

Ilkeston.—The Town Clerk has reported to the District Council *re* the Dover electric trams, and in consequence the Council will hold a special meeting on July 12th to pass a statutory resolution applying for a provisional order under the Tramways Act. At the same meeting a resolution will be brought forward applying for a provisional electric lighting order. The scheme of the General Power Distributing Company is to be opposed.

Ipswich.—After again going into the question of electric lighting for the workhouse, the Workhouse Committee advised that a gas engine be supplied by the gas company for £400, and that Messrs. Crompton & Co.'s tender for the other plant, &c., for the installation be accepted at £1,650. The Board of Guardians, however, rejected the proposal on an amendment, and the matter has been referred back to the committee to get estimates for gas lighting.

Islington.—The Progressives on the Vestry last week ousted Mr. Lambert from the position of Chairman of the Electric Lighting Committee, and appointed Mr. Gordon in his place. We have already briefly referred to this matter.

King's Norton.—The Board of Trade have issued copies of the new provisional order which they have just issued to the Council.

Leigh.—The District Council having obtained an Electric Lighting Order, are proposing to borrow £10,500 to spend on electric works. The estimate of the gas manager, Mr. J. Foster, is that £10,000 will be required for the buildings and plants. The proposed buildings include an engine and accumulator house, concrete foundations for two engines and dynamos, which will cost £1,250; £250 is allowed for the woodwork, and £180 for an eight-ton overhead travelling crane. Under the head of engines, dynamos, &c., £1,150 is allowed for one 80-kilowatt coupled engine and dynamo; £1,300 for the other engine (40-kilowatt dynamo), while the switchboard will cost £700; and the accumulators £1,550. The cost of the main feeders and distributors, including 2,180 yards of triple concentric lead covered distributing main in Queen Street, Bradshawgate, Church Street, King Street, Railway Road, and Market Street, would be £2,885 2s. 6d., £1,100 of this being absorbed under the head of "100 house connections, including service cable meter, cut-out, &c., and fixing at £11. Electric tramways have also been under discussion.

Leith.—By six votes to five, the Council has agreed to authorise the electrical engineer (Mr. Bryson) to advise parties as to the wiring of their premises, with a view to their taking in the Corporation electric light supply; but on condition that the fees received by him be put into a fee fund in the Council's hands, out of which the Council might, at any time they think fit, allow Mr. Bryson any extra remuneration.

Lewisham.—Last week the Blackheath and Greenwich District Electric Light Company wrote to this Vestry that they were concluding negotiations for the purchase of a site for their electricity station at Blackwall point, which would be conveniently situated for the erection of a dust destructor. The company offered to enter into negotiations with the board with a view to the erection of such works for destroying the refuse of the district. A committee will consider the point.

Leyton.—The District Council have resolved to apply for an additional £5,000 for electric lighting, in consequence of increased demand for current. It is proposed to at once erect a new battery station. The electrical engineer has obtained quotations for batteries and accessories from various manufacturers, and an order has been given out, as stated in our "Contracts Closed" this week. Arc lamps are to be placed, by way of experiment, in High Road, Leytonstone.

London.—The St. James's Vestry is requesting the Electric Ligting Company which supplies the district, to reduce the charges for current. The company is understood to have replied, stating that it had done its best for the district, and suggesting that the matter be referred to arbitration.

At last week's Court of Common Council, Mr. Brooke-Hitching's resolution referring the question of the purchase of the undertaking of the City of London Electric Light Company to the Streets Committee for consideration was adjourned. When the Council passed the company's account for £209 odd for one quarter's current for the City Lands Committee, Mr. Norton said that the company's action in reducing the charge from 7d. to 6d. per unit was due to the Court's action in protesting against the high charges.

Luton.—A committee of the Town Council has been considering the electric lighting question, and on 7th inst. its report was submitted to the Council. The committee visited various electricity works in the country and gathered particulars, and had also considered a communication from the Municipal Electric Supply Company. The company laid before the committee the terms upon which they would take over the municipal provisional order, and after detailing various conditions, concluded by saying that the "company is not connected with makers of engines, boilers, dynamos, mains, &c., and is thus quite free from any trade bias in favour of particular machinery." The company is also stated to have expressed a desire to establish a tramway system to Dunstable and Houghton Regis, and the town and suburbs generally. The committee advised the Council to ask Mr. Albion T. Snell whether he would be prepared to meet the committee to confer upon the question, and to carry out the installation proposed for the town. After a long discussion, the proposal was adopted by 14 votes to 1, and a further resolution was passed to the effect that the committee has no further communication with any company.

Macroom.—The Commissioners can get no reply from the contractor (Mr. Thierman, Manchester) for electric lighting of the town. The Town Clerk is to write again requesting a reply, and in the meantime to advertise for a new contractor.

Manchester.—At last week's City Council meeting Alderman Higginbottom (chairman of the Electricity Committee) reminded the Council that the joint report on the subject of electrical supply had just been issued, and that it had gone against municipal authorities. The principle laid down therein did away with what they always considered they had in Corporations, namely, the monopoly and the right over their streets. It would enable any private incorporated electric company to place a generating station outside any city or town, and give notice to the authority inside that the mains were to be laid. That authority would have to do the work and would be paid for doing it. Now this was a position they in Manchester very strongly objected to. The principle affected some four or five Bills at present before Parliament, in one of which Manchester was interested. Lord Morley and Sir Courtenay Boyle had laid down the principle that a tramway company could go to Parliament for a provisional order to equip its lines and work them with electricity; and, having obtained that, it could go to the Board of Trade and ask for a provisional order to supply consumers with the electric light along the whole route, thus entering into competition with the authority. The joint report lay upon the table in Parliament, and it would have to lie there for a certain time. No discussion whatever would take place upon it, which seemed to him to be a very curious thing. It naturally followed, however, that if the principles he had referred to were to be placed in all provisional orders and all other Bills relating to electrical energy in any form, there must be legislation. That being so, the measure would have to be fought step by step in the interests of the Corporation. Upon their supposed monopoly they had borrowed money and laid down plant, and now that monopoly was threatened. It was a state of things which they could not look forward to with any degree of composure, and he hoped the Council would entrust the committee with the necessary authority to protect the interests of the Corporation.

Monmouth.—At last week's Council meeting the report of the Drainage and Electric Light Committee was discussed at great length. The £20,000 borrowed for the carrying out of the combined scheme of drainage and electric light appeared to have been already practically expended while the work was not nearly completed. Mr. Breakwell, chairman of the committee in charge of the scheme, explained that their engineer, Mr. Lailey, had not yet rendered his report. They were therefore unable to give the figures. They were also at a deadlock for money, as the Local Government Board would not sanction the additional loan of £10,000 until they got Mr. Lailey's report explanatory of the extraordinary difference between his original estimate and the actual cost of the work. It was resolved to write to Mr. Lailey again on the subject.

Newcastle.—The Committee which is considering the question of purchase of the electric lighting undertakings met on Monday, but nothing particular was decided, as it is proposed to await the action of the Tramways Committee before drawing up a recommendation.

A main box cover was blown off by an explosion on 7th inst. No one was hurt.

Newport.—A report to the Electricity Committee shows that the number of lights now connected and on order is equivalent to 18,538 of 8 C.P. It has been decided to adopt the electric light for the new Union Workhouse and offices, the estimated number of lights required being 550. The borough electrical engineer submitted his report upon the condition of the plant, which is all in satisfactory working order. A comparison of the capacity of the plant, with the number of lights connected, shows it to be overloaded to a slight extent at the lighest load even at the present time. With reference to the question of obtaining an emergency plant to cope with the demand during the coming winter, pending the delivery of the new plant, the consulting engineer, who attended, reported that he had made a number of inquiries and obtained several offers, which he had considered in conjunction with the chairman. The one they considered most suitable was that of the Sheffield Electric Light and Power Company, Limited, a marine type Brush engine, driving a 100 kw. Mordey alternator by ropes. The engine was in excellent order, but the alternator required re-winding, and the Brush Company proposed to make practically a new machine of it for the sum of £371 77s. 6d., and to deliver in 16 weeks. The company would remove the plant from Sheffield and erect it at Newport for £182. It is recommended that the plant be placed at the far end of the extended engine house, just beyond the foundation for the second 300 kw. set. The total cost is estimated as follows:—

	£	s.	d.
Plant, as it stands at Sheffield	400	0	0
New field magnets and armature coils	371	17	6
Dismantling, carriage, and re-erection	182	0	0
Foundations	60	0	0
Steam and exhaust pipes	20	0	0
Switch gear	0	0	0
Fees and contingencies	116	2	6
	£1,150	0	0

It was assumed that connection would be made to the new steam range at its extreme end, and the switch gear for No. 7 alternator will be available. The matter having been considered, the Council resolved that the plant be purchased and erected. Application is to be at once made as to a loan in respect of this plant and the extension of the low tension distribution system in Commercial Road decided upon at the last meeting. A letter from the Board of Trade approving the additional system for supply of electrical energy and describing their requirements for the construction of transformers, was reported to have been received. The mains are to be extended along Risca Road.

Nottingham.—The Corporation is negotiating for the purchase of property lying between the present works and Hanley Street, for the purpose of extending the electric lighting station, upon whose supplies there is a greatly increased demand.

Poplar.—The Board of Works have asked the Guardians to suspend their own electric lighting of the workhouse pending the supply of the parochial current.

Provisional Orders.—There are at the moment quite a number of Bills before Parliament to confirm provisional orders made by the Board of Trade under the Electric Lighting Acts, and, remarks a daily paper, amongst those of interest to London are orders in regard to Holborn and St. Giles, Bermondsey, and St. Marylebone. As regards Holborn and St. Giles, the undertakers under this order are the County of London and Brush Electric Lighting Company, Limited, and the area of supply is portions of the districts of the Board of Works for the Holborn and St. Giles Districts; while under the other the undertakers are the Charing Cross and Strand Electricity Supply Corporation, Limited, and the area of supply is portions of the districts of the Board of Works for the Holborn and St. Giles Districts. The Bermondsey and Marylebone undertakers are the respective Vestries.

The Middlesbrough and Darlington Electric Lighting Bills were on 10th inst. sent for second reading in the House of Lords.

Rotherhithe.—The Vestry agrees to take a supply of current from the London Electric Supply Corporation at the usual terms, for lighting the Town Hall as soon as the mains are laid there.

Sale.—At the last meeting of the District Council, it was stated that the Manchester Corporation could make arrangements for supplying the electric light to Sale either by way of Stretford or Chorlton-cum-Hardy, and that the price would not exceed 3d. per unit. One speaker was not satisfied with the report on the electric lighting of the township as drafted by Mr. Shaw, and he moved that Prof. Kennedy should be asked to prepare a report and submit a scheme with and without street lighting. The motion had no seconder.

Salford.—The Electric Light Committee has instructed the engineer to proceed with the laying of the cable along Bolton Road. The engineer reported that it was advisable that the committee and the Electric Light Committee of the Manchester Corporation should meet together for the purpose of arranging standard pressure for the working of the tram service, so that the cars might run smoothly on the Salford and Manchester lines. A communication was directed to be made to the Manchester Electric Light Committee, asking them to receive a deputation from this committee upon the subject. A tender from Messrs. W. T. Glover & Co. for the supply of one mile of low tension single cable, lead covered, for the sum of £115, was accepted.

Sheerness.—The first installation of electric light in Sheerness has just been completed, the proprietor of the Bell and Lion Hotel having adopted this method of lighting throughout his premises. He is also supplying a neighbour with the light.

Sheffield.—The Sheffield Chamber of Commerce has passed a resolution in regard to the scheme of the General Power Distributing Company to the effect that it favours the establishment of a competitive supply of electrical energy for Sheffield.

Shrewsbury.—At last Monday's meeting of the Shrewsbury Town Council, the question of purchasing the Shropshire Electric Light Works was carried another stage. The matter has been under consideration for some time. The proposal was vigorously attacked at the last annual meeting of the Shrewsbury Gas Company, both on financial grounds and those of the effectiveness of the illuminant, but the Council were not persuaded from the attempt to buy the undertaking, and negotiations resulted in its being decided on Monday to instruct the Town Clerk to make application to the Local Government Board for sanction to a loan of £35,000 "to complete the purchase of the Shropshire Electric Light and Power Company, and also a sum of £800 for adjoining buildings." It was stated in the discussion that on the Council's getting the works, they will at once proceed to light the town with electricity.

Southport.—The electrical engineer (Mr. C. D. Taite) has just issued his second annual report, showing that during the year the net profit of £643 has been made, as against a loss of £471 in the previous year.

Stanford-le-Hope.—A parish meeting has been discussing the lighting question. Gas and oil systems were considered, and then Mr. Simpson said the firm he represented were prepared to form a local company for the supply of electric light, with a capital of £2,000, of which they were prepared to find one-half if the other were subscribed locally. The price per unit for street lighting would be 4½d., and about 7d. per unit for private use. That capital would be sufficient for 500 lamps of 16 C.P. They would require about 50 for street lighting, which would work out at about £2 12s. per lamp.

Stockton.—Mr. H. P. Boulnois, C.E., held a Local Government Board inquiry last week into the application of the Corporation to borrow money for electric lighting. Borrowing powers to the extent of £30,000 are asked for, and it is proposed to spend £22,000 of this sum at present.

St. Pancras.—At the Vestry meeting on Wednesday last week, the Electricity and Public Lighting Committee reported that they had elected Dr. Walter Smith as chairman for the ensuing year. There were 47 candidates for the position of inspector of works, rendered vacant by the resignation of Mr. J. C. A. Ward, and Mr. F. Alan Wilkinson, superintendent of mains at Bournemouth, has been appointed.

Tunbridge Wells.—On Friday the Tunbridge Wells Improvement Association passed a resolution in favour of the consumer being given a share of the profit made on the Corporation electric light undertaking, by reducing the charge, instead of devoting all the profit to the reduction of the rates.

Twickenham and Teddington.—A proposal is on foot to form a company with the object of supplying electricity to Twickenham and Teddington. A communication made by the company was under consideration by the Twickenham District Council last week, and it was decided to consult the members of the Teddington Council.

Wells.—The Board of Trade has informed the Council that it has no power to extend the time of the provisional order for electric lighting.

Westgate-on-Sea.—The Board of Trade have informed the Isle of Thanet Rural District Council that, after consideration of the report made to them by the inspector appointed to inquire into the matter of the Westgate-on-Sea electric lighting provisional order, they do not propose to proceed with the application.

West Hartlepool.—The Council is to obtain estimates for a dust destructor, which may be used in connection with electric lighting.

Weston-super-Mare.—The Weston and District Electric Light and Power Syndicate has intimated its intention to apply to the Board of Trade to annul the Council's provisional order, and to grant the company a similar order.

Woking.—The Woking Electric Supply Company has agreed to the deductions made from their account for failures. The company is endeavouring to meet the Council's wishes by close attention to the efficiency and upkeep of the street lights.—The District Council last week had a discussion with regard to the dense volumes of smoke which have lately been issuing from the Electric Light Company's works. Mr. Cox thought that indulgence should be granted to the company in order to allow them time to alter their furnaces in such a way as would prevent this nuisance in the future. The company is to be written to on the matter.

Wolverhampton.—At the monthly Council meeting on Monday, the Lighting Committee submitted the electric lighting accounts for the year ended March 31st. The accounts show that a profit of £589 14s. 4d. has been made, after payment of interest and sinking fund. This has been applied to the deficiency on the working of the previous year, reducing the sum to £588 0s. 6d. A few of the figures from the accounts may be interesting. The capital account shows that the amount of loans sanctioned is £47,799 (at 2½ and 3 per cent., and for 25 and 30 years), and that £32,660 was borrowed up to March 31st. A sum of £345 has been repaid. The total capital expenditure up to March 31st was £41,781. The revenue account for the year shows income amounting to £6,257 (including £4,687 by sale at 6d. per unit, and £302 at 3d., £1,275 by sale of current for public lamps, &c.). The expenditure reaches to £3,423, including £2,211 for generator, £247 for repairs to public lamps, £703 management expenses, &c. The credit balance was £2,833. This is set against the capital charges for the year, leaving a net profit of £589 14s. 4d., as above stated. This latter sum is in turn set against the debit balance of £1,177 at March 31st, 1897, reducing it to £588 0s. 6d. The statement of output shows that 370,084 Board of Trade units of current were generated during the year. Of these 291,233 were sold, and 3,931 were used at the works, leaving 74,925 units as waste or leakage. The maximum demand which the works are under covenant to meet is equal to 14,151 32-watt lamps. The committee make the following recommendations:—(1) That from July 1st the price of energy for motor power and heating purposes be fixed at 2d. per unit on a maximum demand for an average of two hours per day, and 1d. per unit for all energy consumed in excess thereof. (2) That application be made to the Local Government Board for a loan to cover capital expenditure in purchasing and hiring out motors to motor power consumers, both on the simple hire and the hire-purchase system, and in the wiring and fitting up by consumers of the premises for electric lighting purposes. (3) That your Committee be empowered to make such terms as they shall deem advisable for the hire of motors and for the repayment of the capital expenditure incurred on behalf of consumers in wiring and fitting up their premises. The above recommendations were agreed to at the meeting of the Council. Alderman Mander said that in 1897 they sold 224,709 units, which was an increase of 14 per cent. on the previous year. But this year they had sold 291,233 units, or an increase of 22 per cent. The number of lamps was in 1896, 8,941; in 1897, 11,307, an increase of 21 per cent; and in 1898, 14,151, an increase of 20 per cent. Their gross profit this year was £2,833 14s. 9d., or 6½ per cent., the net profit being 1 per cent. The Council is to spend £200 upon fitting up the Free Library for electric lighting.

Wolverhampton.—The report of the Lighting Committee was issued to the members of the Council last week. The Committee report that the operations of the year have again been successful. A profit of £589 14s. 4d. has been made after payment of interest and sinking fund. This has been applied to the deficiency on the working of the previous years, reducing the same to £588 0s. 6d.

Worcester.—Last week the Council concurred in an agreement transferring to the National Electric Free Wiring Company, Limited, the rights and obligations of the Electric Free Wiring Syndicate under their agreement with the Council. There was a brief discussion *re* the Brush Company's bill for £365 for additional work and goods supplied, but the bill was passed for payment.

Worthing.—At a meeting of the Council in committee held on May 12th, Alderman Linfield, as chairman of the Electric Lighting Committee, submitted the report of Messrs. Burstall and Monkhouse, electrical engineers, upon the three schemes received by the Committee for the proposed electric lighting of the borough from Messers. Siemens & Co., Edmundson's Electricity Corporation, Limited, and the Municipal Electric Supply Company. It was resolved "That it is expedient to undertake the construction of electric lighting works on the same or similar terms to those contained in the proposal of Messrs. Siemens and Co., keeping the same in their own hands, and requiring the contractors to work the undertaking at a stipulated rental for five or seven years.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Birmingham.—Sir James Smith's name having been mentioned in connection with a letter which was stated to have reached the Birmingham Tramways Company, in which permission had been given to proceed with the overhead wire system, Sir James Smith made a personal explanation at Tuesday's meeting of the City Council, from which it appeared that he had given no authority for any such letter to be sent. It seems that Sir James had a conversation on the matter with a certain gentleman, who wrote to Mr. Ross of the Tramways Company, and quoted a remark made by him. Sir James's explanation was considered perfectly satisfactory.

Brierley Hill.—The District Council had various matters regarding the electric tramway scheme before it last week. It approved of the creosote wood blocks proposed by the British Electric Traction Company for paving, it acceded to the company's application for permission to lay underground electric cables, gave the surveyor instructions that not more than 100 yards of the road should be broken up at one time, resolved not to oppose the application of the Dudley and Stourbridge Electric Traction Company for a renewal of the steam power license for a year (this is merely a formality that must be gone through, as already explained), and has resolved to support the company's application to the Board of Trade for confirmation of the order granted to them by the Light Railway Commissioners for making a light railway for the Cradley Heath district. This application, it should be mentioned, is opposed by the Dudley Corporation. The Stourbridge District Council has also decided to support the company's proposals, and will send representatives to the forthcoming inquiry with that object. The Brierley Hill Council will do likewise.

Bristol.—The Bristol Tramways (Electrical Power, &c.) Bill and the Bristol Tramways (Extensions) Bill were on Tuesday ordered for third reading in the House of Commons.

Cape Town.—The *Westminster Gazette* remarks that the electric car can be made to pay, and pay well; and this seems evident from some figures relating to the Cape Electric Tramways, Limited. For the past six months the revenue has amounted to £66,934, and the expenditure to £29,902, leaving a profit of £37,032, or at the rate of £74,064 a year, which is a handsome return on the capital. The 6 per cent. interest on the £315,000 first debentures, and the 5 per cent. interest on the £115,000 second debentures would absorb £24,650, so that even after paying a 10 per cent. dividend on the £400,000 ordinary shares a balance of nearly £10,000 would be left for reserve fund and other purposes. Of this company, Sir Charles Euan-Smith, K.C.B., is chairman, and amongst the directors are Vice-Admiral A. H. Markham, Mr. John Hays Hammond, Dr. Rutherfoord Harris, and Mr. Alfred Parrish.

Clontarf and Hill of Howth.—A special meeting of the proprietors of the Dublin United Tramways Company was held last week at the office, Upper O'Connell Street, Dublin, for the purpose of considering and approving, or otherwise, of the Bill applied for by the Clontarf and Hill of Howth Tramroad Company in the present session of Parliament. A resolution was adopted approving of the measure, subject to such conditions, alterations, and variations, as Parliament may think fit to make in it. The Bill passed second reading on Tuesday.

Dover.—At last week's meeting of the Finance Committee in connection with the bill from the Dover Electricity Company for £500 for the supply of current to the trams during the last quarter, Alderman Peake said he saw that the Corporation had taken all the power they guaranteed, within £56 worth. The Town Clerk replied that that was so, and when the two new cars arrive—probably this month—the whole of the current will be taken.—Councillor Edwin said he saw the amount charged in the company's bill was £56 19s.

for unused current. Would they get credit for this sum if they used over the guaranteed amount during the year?—The Town Clerk: Yes, an average is struck.

Dublin.—Major Cardew made a Board of Trade inspection on 7th inst. of the new electric line between Haddington Road and Nelson's Pillar. He was accompanied by Mr. Anderson, J.P., secretary and manager of the company; Mr. Astrow, engineer in charge of the new electric service; and Mr. Towle, electrical engineer. A journey was made from Haddington Road to the Pillar, and the line and rolling stock were found to be in good order. Some of the underground work still remains to be completed, so that the new service will not be open for traffic for a few days yet.

The Corporation will not allow electric tramways to be run through Phœnix Park.

Glasgow.—The question of the electrolysis of the gas and water mains, as the result of the working of the Springburn tramway route by electric energy, having been recently raised, the subject was remitted to a joint sub-committee of the Gas and Water Committees for consideration. The sub-committee referred the question to Mr. Chamen, the electrical engineer to the Corporation, who has just presented an elaborate report, in which, says the *Glasgow Herald*, he discusses the subject in all its bearings. Having considered this report and received further verbal explanations, the joint sub-committee have resolved to report (1) that if the Tramway Department observe and carry out the rules and regulations of the Board of Trade with respect to the construction and maintenance of the electric tramways, there does not appear to be any danger of the gas and water mains along the route being injuriously affected by electrolysis from the action of the return current along the tramway rails or otherwise; and (2) that the electrical engineer should report to the engineers of the Gas and Water Departments respectively any further facts or circumstances which may from time to time hereafter come to his knowledge in regard to any of the matters dealt with in his report.

Great Northern and City Railway.—The secretary of the new company informs a financial paper that the size of the electrical locomotive required to haul the Great Northern Railway Company's suburban trains, consisting of 11 coaches, and seating 500 passengers, from Finsbury Park to Moorgate Street station, will be very moderate, compared with some of those in successful use in the United States, where trains of five times the weight are satisfactorily hauled by electric locomotives.

Hastings and Bexhill.—Last week an inquiry was held at Hastings by the Light Railways Commissioners regarding the scheme of the Hastings, Bexhill, and District Light Railways Company. The inquiry came to an abrupt termination, the chairman stating that the Commissioners considered that as there was a feeling of great opposition to tramways, although the majority of the Council was in favour of the project, they did not think it desirable to try and force upon the town a scheme which was not generally acceptable.

Huddersfield.—The Council has resolved that the new tramway rails at present being manufactured for the Corporation, be ordered to be drilled so as to be applicable for electric traction.

Hull.—Laying the first rail of the electric tramways was made the occasion of a public ceremony on the 9th inst., the Mayor and Corporation being present. There were speeches by local dignitaries, and in the evening Alderman Larard, chairman of the Works Committee, entertained his colleagues on the committee with their wives and a number of friends, to dinner at the Town Hall.

King's Norton.—The Clerk to the District Council has been instructed to write to the Town Clerk of Birmingham, pointing out that that body is opposed to overhead electric tramways, and expressing the hope that the Corporation would not sanction experiments upon any of the tramways within the city which had their terminus in the district of the Council.

Kirkcaldy.—On Monday night the Town Council had before them Prof. Kennedy's report as to the proposed introduction of the electric lighting and trams. The report shows the proposed route of the tramway to be 6½ miles, with circular routes from West Bridge by the Public Park, Victoria Road, to Pathhead, and thence to Gallatown; also along Links Street, High Street, and Sands Road. A branch line will be made to provide for station traffic by placing a line up Whyte's Causeway and Wemyssfield to join the upper routes. The Provost intimated that a private company which had the matter in hand was desirous of allowing the Council to take up the scheme, failing which they would take up the matter and float the scheme. The cost, he considered, would be nothing less than £100,000. In view of the limited time at the disposal of the promoters to enable them to apply for a Bill, it was agreed to hold a special meeting to consider the whole matter, and give a final decision in July.

The London United Tramways Bill.—This Bill came before a Select Committee of the House of Commons on Thursday last week. Mr. Little, Q.C., who appeard for the promoters, explained the objects of the measure. It contemplates, says the *Times* report, the construction of a series of new tramways, one from Acton to Hanwell, over two miles in length along the Uxbridge Road, another from Hanwell to Brentford, one mile one furlong in length along the Boston Road, and another from Kew Bridge to Hounslow, two miles four furlongs in length. It is proposed to carry a line over Kew Bridge when the contemplated new structure is completed. The new lines will pass through the districts of Acton, Ealing, Hanwell, Brentford, and Heston and Isleworth. They are to be worked by electricity, on the overhead trolley system. The learned counsel pointed out that another object of the Bill was to enable the promoters to work their existing lines from the Uxbridge Road station to the boundary of Acton and from the same place to Kew Bridge, and from Hammersmith Broadway, by loop, to a place on the last-named line, by electricity. The districts through which the new lines would run were well populated, and the service of omnibuses was not efficient. He further pointed out that the chief opponents of the Bill were the Ealing local authorities and the London County Council. The Middlesex County Council also petitioned against the Bill. Inside London the London County Council and the Hammersmith Vestry seemed both to be in a condition of absolute darkness as to the existence of overhead wires elsewhere, and they opposed the Bill. The proposal originally made by the company to use mechanical power on their line to Richmond had been withdrawn for the present. The Hammersmith Vestry, after being consulted by the company, had sent a deputation to Havre to see the working of the overhead system there and had unanimously approved the adoption of the system, but it had since altered its mind and decided to oppose the Bill. The Ealing District Council had agreed by a majority of one only to oppose the Bill.

The first witness called on behalf of the promoters was Mr. Clifton Robinson, managing director and engineer of the London United Tramways Company. In examination by Mr. Balfour Browne, Q.C., he said that 8½ millions of passengers were carried over the existing lines last year. He had had considerable experience of other tramways, and that experience taught him that the introduction of electric traction doubled the volume of traffic. He estimated that if such traction were introduced and the proposed extensions were made to Hounslow and Hanwell the company would carry 25,000,000 of passengers every year. His experience further showed that, with the advent of electricity, the best results would be obtained by the reduction of fares by at least one-half. The fares charged on workmen's cars would be half the ordinary fares. As far as he knew there had never been an accident owing to the use of overhead tramway wires.

In cross-examination by Mr. Pope, Q.C. (on behalf of the London County Council), witness said that the County Council had at present the right to approve or negative the use of electric traction within the county of London. The company had sent three deputations to the County Council, one of them being supported by the Hammersmith Vestry. Having been unable to overcome the County Council's ill-advised obstruction to a popular mode of traction, the company had resolved to appeal to Parliament. It was the case that the company proposed to substitute the Board of Trade as the controlling authority in connection with these matters for the London County Council. The County Council had the right to purchase the company's undertaking in 11 years' time.

Sir J. Brunner asked whether any tramway in London was worked by electric traction at present.

Mr. Pope replied that there were none.

Sir J. Brunner asked whether the County Council had opposed all applications for power to use electric traction.

Mr. Pope said they had not. They were not opposed to electric traction, but, generally speaking, they were opposed to overhead wires.

Replying to Colonel Welby, witness stated that the average life of a horse employed on a tramway did not exceed five years, no matter how well it was selected or how well it was taken care of.

In answer to further questions witness strenuously denied that an electric tramcar made as much noise as an ordinary motor-car, and said that an electric tramcar glided along like a boat on ice. He expressed the opinion that electric traction had now reached such a point that there could be no opposition to it that was not factious.

The committee resumed its investigation on Friday. Evidence in support of the Bill was given by gentlemen who had had experience of such tramways in Dublin, Dover, and Wednesbury, and the committee adjourned.

The committee had the Bill before it again on Tuesday. The question of the opposition was discussed between counsel and the committee.

Wednesday's proceedings before the committee consisted of evidence from residents in favour of the scheme, and technical evidence by Mr. Alex. Siemens and Dr. John Hopkinson in favour of the overhead trolley. Dr. Hopkinson said that so far as there was any force in the objection of the London County Council to the Bill, he thought the objection might be met by proposing to the tramway company that they should agree with the County Council that, in the event of the latter body constructing a conduit electric tramway in continuation of the company's tramway, they would themselves introduce the conduit system as far as the county boundary.—Mr. L. Coward (for the company) said his clients would be prepared to enter into such an agreement.—Mr. J. Swinburne also gave evidence.

Manchester.—At a meeting of the Electricity Committee of the Manchester Corporation held on Tuesday, a deputation attended from the Salford Corporation for the purpose of conferring on the subject of the proposed electrical traction for tramcars. Manchester has decided that when electricity forms the motive power on the tramways the pressure shall be 400 volts, which will suffice for both lighting and traction purposes. It is desirable that the pressure shall be the same in Salford as in Manchester, and the Salford Corporation will now doubtless make arrangements for supplying a pressure similar to that which will be given in Manchester.

Middlesbrough.—Last week several trips were made over the entire length of the electric tramway from here to Stockton, partly for the education of drivers and conductors. The opening day is not yet fixed. The Government inspection will have to be held first.

Merthyr Tydfil.—The Roads and Bridges Committee of the Glamorgan County Council has decided to recommend the Council to take steps to oppose the scheme being promoted in the Merthyr Tydfil Light Railway Order for the construction of electric railways, and to intimate to the Local District Council that in the event of the scheme being carried out the Council would discontinue its contributions to the maintenance of the roads in the district. The principal of these lines would run for part of its length along a road contributed to by the County Council, a great deal of which was of insufficient width to admit of a railway or tramway with safety to the public.

Morecambe.—It is proposed to erect a novel tower for the east end of the town. The tower will be illuminated by electric lights and an electric car will run underneath the spiral roadway. At the apex of the tower will be a search light of great power showing its light for 20 miles. There will be a special electric lighting plant put down for supplying the requirements of the tower.

Norwich.—The Norwich Electric Tramways Bill was read a third time on Tuesday.

Rochester.—A committee of the Corporation has received a deputation consisting of Mr. Henry Jasper and Mr. Atherton (promoters), Messrs. Giepel and Walters (engineers), and Mr. A. R. Norman (solicitor), *re* a scheme for the construction of a light railway partly within the city. Plans, sections and other particulars are in the Town Clerk's possession.

Ryde.—The Ryde Pier Company are stated in a daily paper to be making preparations for the season by improving their electric railway, and placing it on a stronger and better foundation.

Southborough. — The Southborough tradesmen are opposed to the proposed electrical tramway from Tunbridge Wells to Southborough on the ground that it will induce customers to shop at Tunbridge Wells.

St. Helens.—At the last meeting of the Borough Council the Mayor moved the confirmation of the minutes of the Electric Lighting and Traction Committee, in which were set out the arrangements come to in regard to equipping the tram lines and supplying electrical current for the new electrical tramcars The St. Helens Tramway Company will continue to run the trams and provide rolling stock, and the Corporation have undertaken to supply electricity from the depôt in Boundary Road at the following rates:—2d. per unit on a guaranteed consumption of 200 000 units per annum; 1½d. per unit for 400,000 units; 1¼d. per unit for 600,000 units; and 1d. per unit if the tramways are extended in such a manner as to require 800,000 units per annum. The fixed rent per annum at present paid by the company will be increased to £2,700 when the Prescot and Denton's Green sections are ready for work, and to £3,000 per annum when the whole of the present lines are worked by electricity. This arrangement as to rent is to continue for seven years.—After several questions had been put by Councillor Burchall, the minutes were approved.—The Mayor remarked that they hoped to have the work of converting the tramways from steam to electricity done quicker than was at first anticipated.

TELEGRAPH AND TELEPHONE NOTES.

The "Brazilian" and "Western and Brazilian."—*Money* understands that the agreement between these two telegraph companies will be issued in about a week, and that by its terms the Western and Brazilian deferred shares will be found to be worth about £6 each.

Chatham Telephones.—The Corporation has given the National Telephone Company consent, on certain conditions, to change their service over to the twin wire system.

China Cables.—"Secohm," writing to the *Westminster Gazette*, says that it is important to know at what point the projected cable to Wei-hai-Wei is to be connected to the existing cable systems. "If at Shanghai, as is probable, do not let us forget that the cable office there is a Russo-English one; the Russian interest, according to your Danish interviewee, having taken the place of the previous Danish property."

The Telegraph Wire Export Trade.—The month of May has proved to be a very quiet one as regards the exports from this country of telegraph wire and parts connected therewith, the value for the month having only amounted to £41,944 as compared with £64,883 in the preceding month, £61,226 in May last year, and £112,215 in May, 1896. For the five months ending with May the exports have attained a value of £355,615, as against £382,386 in the corresponding period of last year, and £323,583 in the first five months of 1896.

Telegraphic Isolation of the Cape.—From the daily press we learn that the cable which runs between Mozambique and Delagoa Bay, on the East Coast of Africa, broke down on the evening of the 13th, since which time there has been no means of cable communication with the Cape and the Transvaal, as the cables along the West Coast of Africa have not been available since June 3rd, on which date the cable between Loanda and St. Thomé was interrupted. The following is a list of interruptions to the cables to the Cape during the last 15 months, from which it will be seen that, if anything, the West Coast is less trustworthy than the East Coast route. An examination of the dates will show that in August last the Cape was quite cut off, and that on various other occasions the West Coast route has been only just restored when the East Coast cables fail, and *vice versâ*:—

Cables.	Down.	Repaired.
East Coast Route.		
Durban-Lourenco Marques	May 29th, 1897 ...	June 6th, 1897
Aden-Zanzibar	July 28th, 1897 ...	Sept. 5th, 1897
Mozambique-Lourenco Marques	Sept. 4th, 1897 ...	„ 22nd, 1897
„ „ ...	Oct. 14th, 1897 ...	Oct. 20th, 1897
Aden-Zanzibar	Feb. 28th, 1898 ...	March 4th, 1898
Durban-Lourenco Marques	Mar. 19th, 1898 ...	„ 25th, 1898
„ „	May 14th, 1898 ...	May 20th, 1898
Aden-Zanzibar	„ 24th, 1898 ...	„ 25th, 1898
Mozambique-Lourenco Marques	June 13th, 1898 ...	(still interrupted)
West Coast Route.		
Benguela-Mossamedes ...	April 14th, 1897 ...	May 1st, 1897
Sierra Leone-Conakry ...	„ 28th, 1897 ...	„ 24th, 1897
Accra-Kotonou	July 15th, 1897 ...	July 24th, 1897
Cape Town-Mossamedes ...	„ 19th, 1897 ...	„ 28th, 1897
„ „ ...	Aug 7th, 1897 ...	Aug. 10th, 1897
Loanda-St. Thomé ...	Nov. 8th, 1897 ...	Nov. 29th, 1897
„ „ ...	Dec. 4th, 1897 ...	Dec. 12th, 1897
„ „ ...	„ 13th, 1897 ...	Jan. 10th, 1898
„ „ ...	Mar. 17th, 1898 ...	—
Sierra Leone-Accra ...	April 9th, 1898 ...	April 19th, 1898
Benguela-Mossamedes ...	„ 20th, 1898 ...	May 5th, 1898
Cape Town-Mossamedes ..	„ 14th, 1898 ...	„ 5th, 1898
Kotonou-St. Thomé ...	„ 27th, 1898 ...	„ 25th, 1898
Loanda-St. Thomé ...	May 4th, 1898 ...	„ 14th, 1898
„ „ ...	June 3rd, 1898 ...	(still interrupted)

The Telephone Service.—In connection with the London County Council Telephone Conference, a report of which appears in another column, the *City Press* quotes the resolution passed: "That, in the event of the Post Office not undertaking a telephone service, it is desirable that the local and central authorities of London should at once combine to secure an efficient and cheap service," and adds editorially, "We agree that in one way or another the metropolis must have an efficient service on reasonable terms." This seems to be the general opinion of all who have anything to do with the service.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	**April 6th, 1893 ...**	...
West Indies—		
St. Croix-Trinidad ...	**Nov. 30th, 1896 ...**	...
Mole-St. Nicholas-Caimanera	June 10th, 1898 ...	...
Caimanera-Santiago de Cuba	June 10th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Cyprus-Latakia	Feb. 10th, 1898 ...	...
Bolama-Bissao	April 12th, 1898 ...	...
Maranham-Para	„ 17th, 1898 ...	...
Hong Kong-Manila	May 3rd, 1898 ...	...
Loanda-San Thomé ...	June 3rd, 1898 ...	...
Mozambique-Lourenco Marques	June 14th, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Cartagena-Barranquilla ...	July 4th, 1896 ...	...
Volo-Larissa	June 8th, 1898 ...	...
Saigon-Bangkok	June 11th, 1898 ...	June 14th, 1898.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnet.—June 24th. The Lighting Committee want tenders from firms willing to undertake such installation for lighting the district by electricity. Particulars at the Council offices, and see "Official Notices" June 10th.

Belfast.—June 22nd. The Corporation wants tenders for the supply of turned and bored C. I. pipes and C. I. bell mouths for electric cable conduits. Particulars from Mr. V. A H. McCowen, Corporation electrical engineer; also see our "Official Notices" this week.

Bethnal Green.—June 28th. The Board of Guardians invite tenders for supplying the necessary plant and installing the electric light at the new infirmary, Palestine Place. For particulars see our "Official Notices" June 10th.

Bournemouth.—June 20th. The Corporation is inviting tenders for the supply, &c., of cables, arc lamps, incandescent lamps, wiring, switchboards, fittings, &c.; also steam dynamo, &c. Particulars from the borough engineer, Mr. F. W. Lacey, also see our "Official Notices" May 27th.

Bulgaria.—June 27th. Some little time ago the municipal authorities of Sophia, Bulgaria, invited tenders for the concession for the electric lighting of the public streets of the city, and for the construction and working of an electric tramway. The authorities are again inviting tenders, until the 27th inst., for this concession, particulars of which may be obtained from above.

Cardiff.—June 28th. The Corporation wants tenders for two water-tube boilers for the electricity works. Particulars from the borough electrical engineer, Mr. Appelbee; also see our "Official Notices."

East London (Cape Colony).—June 28th. The Town Council is inviting tenders for erection of buildings and the supply of electric lighting machinery, electric tramcars, plant, rails, &c., and for their maintenance for six months from completion. Particulars from Messrs. Dyer & Dyer, 17, Aldermanbury, London, E.C., on payment of £5, repayable on the receipt of a *bond fide* tender.

Edinburgh.—June 30th. The Corporation wants tenders for the supply of copper strip for electric conductors. Particulars from the resident electrical engineer, and see our "Official Notices" this week.

France.—June 30th. Tenders are being invited by the municipal authorities of St. Laurent de la Salanque, a small town of about 4,500 inhabitants in the Pyrenées Orientales, for the concession for the electric lighting of the public streets. Full particulars may be obtained from, and tenders to be sent to, Le Maire, de St. Laurent de la Salanque, Pyrenées Orientales, France.

Heckmondwike.—June 30th. The directors of the Heckmondwike Industrial Co-operative Wholesale Society want tenders for an electric light installation (about 500 lights) including generating plant for their premises. Consulting electrical engineer, Mr. Walter Leake, 51, Victoria Buildings, Manchester. See our "Official Notices" this week.

Hull.—July 1st. The Corporation wants tenders for wiring and the supply of fittings for the East Hull Baths. Particulars from the city engineer (Mr. A. E. White). See our "Official Notices" this week.

Leeds.—June 16th. The Council requires tenders for two engines and dynamos of about 1,000 H.P. each; also for 50 electric tramcars. Particulars from Dr. John Hopkinson; also see our "Official Notices."

London.—June 21st. The London County Council is inviting tenders for engines, dynamos, accumulators, switchboards, feeders, distributors, and service mains and all accessories, to be fixed complete in buildings at the Crossness Outfall Works, near Erith, Kent. The L.C.C. also requires tenders for providing and fixing cables, wires, conductors, casing, pendants, brackets, and other fittings, columns, lanterns, lamps, switches, and switchboards, distributing boards, fuses, cut-outs, &c., necessary for the lighting by electricity of the Crossness pumping station and works, near Erith, Kent. Particulars of both contracts from the Engineer's Department, County Hall, Spring Gardens, S.W. See also our "Official Notices" May 27th.

Newington.—July 1st. The Vestry of St. Mary invites tenders for the construction, supply, and erection of boilers, pumps, steam and water mains, water tank, surface condenser, fuel economiser, &c., for the electricity works in Penrose Street, Walworth. Consulting engineers, Messrs. Kincaid, Waller & Manville. See our "Official Notices" this week.

Southampton.—June 20th. The Corporation invites tenders for the supply and erection of lamp columns, arc and incandescent lamps, automatic switches and fittings. Consulting engineers, Messrs. Kincaid, Waller & Manville. See our "Official Notices" June 3rd.

Tynemouth.—June 20th. The Corporation wants tenders for the supply of steam dynamos, balancer and boosters, &c. Consulting engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" June 3rd, for particulars.

Victoria.—June 24th. The Council of the city of Hawthorne (Colony of Victoria, Australia) is inviting tenders for the supply and erection of buildings, boilers, engines, dynamos, transformers, mains, meters, arc lamps, poles; also running the plant for three years. See our "Official Notices" March 11th.

Wimbledon.—June 27th. The District Council wants tenders for the installation of the electric light mains and fittings in the new depôt buildings in Queen's Road, Wimbledon. Particulars from the Council's engineer, Mr. C. H. Cooper. See our "Official Notices" this week.

York.—June 24th. The Corporation is inviting tenders for the erection of an electric light station. Particulars from the City engineer, Guildhall.

CLOSED.

Aberdeen.—A committee of the Harbour Board has accepted the tender of Messrs. Lucy & Co., Oxford, to erect lamps and standards for the electric lighting of the Quays.

Belgium.—Mr. G. Boty, of Brussels, submitted the lowest tender (12,387 fr.) for the installation of electric lighting in the Bibliothèque Royale, Place du Musée, Brussels. Three other firms tendered.

Hammersmith.—It is proposed to give Messrs. Ferranti the contract for the extension of the rectifiers and switching apparatus, at £640 and £154 respectively.

Leyton.—The contract for a secondary battery for the District Council has been given to the "Hart" Secondary Battery Company, Limited, The battery consists of 170 cells of a capacity of 1,100 ampere hours at a normal discharge rate of 200 amperes and a maximum discharge rate of 600 amperes for 1 hour. The following were the tenders received:—

Headland Battery Company, Limited	£1,402 0
"Hart" Secondary Battery Syndicate, Limited *(accepted)*	1,480 0
General Electric Company, Limited	1,526 0
E. P. S. Company	1,563 10
Tudor Accumulator Company, Limited	1,780 0
Chloride Electric Storage Company, Limited	1,980 0
Epstein Accumulator Company	2,081 0
D.P. Battery Company, Limited..	2,400 0

Sunderland.—The tender of Messrs. Abbott & Co., of Gateshead, for steam piping, has been accepted by the Council in connection with the electric lighting extensions.

FORTHCOMING EVENT.

1898.

Friday, June 24th at 5 p.m.—Physical Society. Agenda:—1. Exhibition of an Apparatus illustrating the action of two coupled Electric Motors, by Prof. Carus-Wilson; 2. Exhibition of Weedon's Expansion of Solids Apparatus, by Mr. J. Quick; 3. "On the Theory of the Hall Effect in a Binary Electrolyte." By F. G. Donnan, M.A., Ph. D.

NOTES.

Société Internationale des Electriciens.—The monthly meeting of the Société des Electriciens was held on June 1st at 8.30 p.m., with M. R. V. Picou in the chair. M. Ducretet performed a series of experiments on the Hertz system of wireless telegraphy with M. Branly's radio-conducting tube, and various other accessories invented by him. At the transmitting station we find, in the first place, a battery feeding a small electro-motor which works a mercury interrupter. This interrupter is introduced into the circuit which supplies the energy to the inductive circuit of a Ruhmkorff coil. The current which is derived from a special battery passes through the interrupter, a hand switch which is also worked by mercury, and which enables the circuit to be very quickly opened and closed, and the inductive circuit of a Ruhmkorff coil, which is capable of producing a spark ·4 of a metre in length. The two extremities of the induced circuit meet an oscillator which consists of two balls placed opposite to two separate rods, which meet two spheres placed in an insulating liquid. It is in this medium that the spark is emitted. One of the wires of the induced circuit is connected to earth, and the other to a large vertical insulated rod. The electric waves start from this rod and proceed to a receiving station where are installed a Branly radio-conducting tube with an automatic tapper and an automatic Morse register. All the electric waves sent into the atmosphere are registered automatically. M. X. Gosselin then showed in projection some of the best known potentiometers at present employed in various industries.

The Ameer and the Dynamo.—If any of our readers should desire to obtain any further particulars of the career of Sir Thos. Salter Pyne, to which we alluded on page 790 of last week's issue, we would refer them to the April issue of the *Indian and Eastern Engineer*, from whence our information was derived.

The Alexandra Palace Electric Tramway.—The Electricitäts-Gesellschaft Wandruszka & Cie, of Berlin, who are the general European agents for the Steel Motor and Johnson Company, in Johnstown and Lorrain, U.S.A., some months ago entered into an agreement by which they had to erect and work an electric railway in the grounds of the Alexandra Palace. As already mentioned in our columns the line has been in operation since May 15th, and is giving satisfaction. The length of the line is 1·2 miles, on which four motor cars, of a seating capacity of 50 passengers each, are running. The mean takings have proved up to the present to be £12 5s. per day, a good result. The track is double and of ordinary gauge throughout, and the line is equipped with overhead wires on centre poles. At the generating station, the generating plant is in duplicate for the purpose of reserve. The average gradient of the whole line is 1 in 13. The motor cars are fitted with double equipments of the Steel Motor, type 18. On the highest gradient, which is 1 in 11, the motors want a supply of current equal to 37 amperes, with an E.M.F. of 510 volts. Although the seating capacity of the cars is stated as 50, we are informed that they have been carrying 64 passengers.

Municipal Electrical Association.—At the business meeting of this Association, held at the Royal United Service Institution, Whitehall, S.W., on Saturday last, it was resolved to hold the next Convention in Bristol, and Mr. H. Faraday Proctor was elected President. Mr. J. H. Ryder, of Plymouth, and Mr. G. H. Cottam, of Hampstead, were elected Vice-Presidents; Mr. Wilmshurst, Halifax, and Mr. J. F. C. Snell, Sunderland, being elected members of the Council, to serve three years. Bailie Maclay, Glasgow, and Dr. Panton, Bolton, were also elected members of the Council, each to serve one year. Mr. G. H. Cottam was re-elected hon. treasurer, and Mr. W. A. Godfrey hon. auditor. The President stated that the Council had had such valuable help from Councillor Pearson, of Bristol, that they found with extreme regret the fact that, under the constitution, he was not eligible to serve upon the Council during the coming year, and with the idea of retaining his valuable help, and his great knowledge of legal matters, it was considered desirable by the Council to ask the Association to appoint Mr. Pearson as hon. solicitor, and he was elected unanimously. The appointment of hon. secretary was left with the Council.

Electrical Engineers wanted by the War Office.—We understand that the Under-Secretary of State for War, War Office, London, is to appoint an electrical engineer with thorough mechanical and electrical training and experience of electric lighting work, including the distribution of current. He will be required to assist in the preparation of particulars and supervision of the execution of electric lighting contracts at Aldershot. An electrical and mechanical draughtsman is also required for the preparation of plans and record drawings in connection with the above. He must be thoroughly competent, and must have had experience in the office of a consulting electrical engineer or contractor for large electric light installations. Applications, by letter only, stating age, experience, and salary required, and furnishing references, to Under-Secretary of State for War, War Office, London.

Röntgen Rays in War.—In the House of Commons on Friday last week, in reply to General Russell, Mr. Brodrick said:—The Röntgen ray apparatus, which is a very recent invention, is very difficult to adapt for field service, and was not carried with the field army in the recent operations. From the returns the medical authorities do not consider there was a single case in which life could have been saved by the use of the apparatus. Two sets are now in Egypt, and one more will be sent out shortly. Two have been adapted as far as possible for field service, and one is for use in the base hospital. Sir J. Fergusson asked whether 400 men were not wounded by bullets, and whether the apparatus would not have been most useful in locating the bullets. Mr. Brodrick.—The senior medical officer has gone carefully into the cases and has been unable to trace any single case in which the apparatus would have been specially useful or in which an operation would have been carried out more successfully by the use of the rays.

Wireless Telegraphy.—The following copy of a letter addressed to the President of the Académie des Sciences, Paris, June 12th, 1898, has been handed to us for publication:—

"Sir,—The first station for the *Hertz system of wireless telegraphy* is established at my works. The mast rises to a height of 26 metres from the ground (the height of the ground is about 55 metres). This mast overtops the neighbouring houses, and can be seen from a great distance. The conducting wire, which is insulated and attached to the top of this mast is 32 metres long. This collector of the electric waves goes into my laboratory, and is connected with one of the electrodes of the Branly *radio-conductor* of the receiving station, the other electrode is connected to earth.

"Yesterday, Saturday, from 2.30 to 3.40 p.m., during the storm my *automatic receiver* registered 311 *intermittent atmospheric discharges* as they made their presence felt on the *collecting mast*. These discharges were registered *before* the appearance of the lightning and the noise of the thunder.—Believe me, Sir, your devoted and obedient servant, E. Ducretet.

This note cancels that dated the 7th, which is less complete, the collecting mast not having been erected at that date."

The Langdon-Davies Motor.—The Davies Motor Company inform us that the manufacture of the Langdon-Davies motor having grown too large to be carried on in their present works, they have transferred the English manufacturing rights to a new company under the name of the Langdon-Davies Electric Motor Company, Limited, which has taken and equipped considerably larger works at 101, Southwark Street, S.E., to whom all communications on the subject of motors should be addressed. The instrument business, with the exception of ammeters, voltmeters, and the other electric lighting instruments still continues at the above address as for the eight years past, and previously to that at Westminster. The company has reverted to the old name of Nalder Bros. & Co., Limited, and its business will be carried on, as it has continuously been for the past 10 years, under the two partners in the original firm of Nalder & Co., Messrs. Crawley and Soames, as its managing directors, and with the same staff. To prevent confusion, the business previously carried on at 16, Red Lion Street, is now divided into the three following totally distinct concerns, the latter two having taken over the branches specified:—Nalder Bros. & Co., Limited, as above. Nalder Bros. & Thompson, 34, Queen Street, Cheapside, E.C., ammeters, voltmeters, switchboards, &c. The Langdon-Davies Electric Motor Company, Limited, 101, Southwark Street, S.E., alternate current motors.

British Association, Bristol, 1898.—The local hon. secretaries, Messrs. Arthur Lee and Bertram M. H. Rogers, are sending out the report of the executive of the B.A. Local Committee held on June 6th, giving details of the arrangements which are being made for the September meeting at Bristol. Particulars as to presidents of the various sections and other information appeared in our April 8th issue.

Personal.—Mr. George C. Sillar, M.Inst.E.E., who for nearly 17 years has been connected with the Brush Electrical Engineering Company, Limited, in various capacities, has been appointed general manager of the Otis Elevator Company, Limited, Queen Victoria Street.

Mr. W. H. Allen, of the Queen's Engineering Works, Bedford, is now a justice of the peace for Bedfordshire.

Forthcoming Prospectus.—*The World* understands that the prospectus of the "Cotsworth" Arc Lamp and Electric Lighting Syndicate, Limited, will be issued at no remote date. "The lamp is said to be the simplest ever offered to the public, while the cost of production is estimated at a very low figure."

Will.—The late Mr. Thos. Holliday, Edgerton, Huddersfield, of the firm of Read, Holliday & Co., Limited, electrical engineers, &c., has left gross estate £108,618 16s. 1d.

Marriages.—Mr. Guy C. Fricker, of Messrs. Fricker, Miller & Co., was married on Wednesday last week, June 8th, to Miss Lena Bockett, third daughter of the late Mr. John Bockett, solicitor, Lincoln's Inn Fields. The "happy pair" have gone for a three weeks' tour in Switzerland.

Mr. Thomas Harding Churton was married on 8th inst. to Ethel Blanche, younger daughter of Marshall Nicholson, Esq., of Middleton Hall, Leeds, at St. Mary's Church, Middleton. Mr. Harding Churton, of Leeds, needs no introduction to the electrical fraternity.

"Stand-by Charges."—Mr. Robert C. Quin, the borough electrical and tramway engineer at Blackpool, read a paper before the Municipal Electrical Association on "Stand-by Charges," raising the question of the unfairness to electrical undertakers to be compelled to find capital for plant usually lying idle to supply consumers whose premises are equipped with their own generating plant. We refrain from commenting on this paper, as the Council of the Association decided at the last moment to withdraw it from discussion, and to make it the subject of a report from their body.

Blackpool and the Overhead Trolley.—We understand that, after careful consideration, the Board of Trade has decided to sanction the overhead trolley system of electric traction on the Corporation tramways on the condition that the special regulations made by the department are strictly complied with.

Paris Exhibition of 1900.—The Royal Commission, of which the Prince of Wales is chairman, are now prepared to circulate information respecting the Exhibition. The classification and rules for exhibitors, together with forms of application for space, can be obtained by applying to the Secretary of the Royal Commission, Paris Exhibition 1900, St. Stephen's House, Westminster, S.W.

Presentation.—On 7th inst., the superintendent engineer of the Northern Electrical Engineering and Plating Company, Limited (Mr. Thomas W. Ogilvy), was, at Newcastle, presented with a handsome cruet and a pair of bronze ornaments subscribed for by the employés of the firm on the occasion of his marriage.

Burglary.—Messrs. E. P. Allam & Co., electrical engineers, of 14, Hatton Garden, E.C., ask us to state that a few days ago their premises were broken into and an Evershed generator, No. 125, and a Nalder Bros. ohmmeter, No. 6,418, were stolen. They will be pleased to reward anyone giving information which will lead to the recovery of the instruments and the apprehension of the culprit.

"Truth" on Trams.—After condemning the existing tram service at Hull, Labby asks in *Truth*: "Why does not the municipality start electric trams?" and proceeds to eulogise the overhead trolley system. We are quite at one with him in this matter, but he is not *au fait* in regard to the progress of mechanical traction, or he would know that the Hull Council some time ago gave out contracts for electrical equipment of the trams on the trolley system, and the first rail was laid last week.

Verband Deutscher Electrotechniker.—The sixth annual meeting of the Verband Deutscher Electrotechniker was held at Frankfort-on-Main from the 2nd to the 5th inst. Among the papers read was one by Dr. Th. Bruger "On a Direct Indicating Phase Meter," and one by Dr. M. Levi on "Progress with Röntgen Rays."

The Royal Society.—The following papers were down for reading yesterday afternoon:—C. Coleridge Farr, "On some Expressions for the Radial and Axial Components of the Magnetic Force in the Interior of Solenoids of Circular Cross Section." A. A. C. Swinton, "On the Source of the Röntgen Rays in Focus Tubes." Prof. W. Ramsay, F.R.S., and M. W. Travers, "On the Constituents of Argon."

Appointment Vacant.—The Croydon County Polytechnic is wanting a teacher of electrical engineering. For particulars of qualifications, &c., see our "Official Notices" this week.

NEW COMPANIES REGISTERED.

Asbestos and Rubber Company, Limited (57,673).—Registered June 7th, with capital £10,000 in £1 shares, to acquire the business carried on by Stanley, Morrison & Co. at Hull and Sheffield, to adopt a certain agreement, and to carry on the business of India-rubber, gutta-percha, and asbestos manufacturers, ship and engineers' stores manufacturers, electricians, telegraph and electrical engineers and contractors, cable and telegraphic instrument manufacturers. The subscribers (with one share each) are:—T. B. Hooper, 15, Old Jewry Chambers, E.C., solicitor; E. B. Morrison, 33, Greencroft Gardens, N.W., gentleman; R. M. Albery, Bowery Farm House, Wraysbury, Bucks, farmer; B. S. Ince, 1, Church Court, Old Jewry, E.C., printer; H. Pearce, 129, Cheapside, E.C., stationer; F. D. Leslie, 74, Coleman Street, E.C., accountant; O. M. Bolton, 431, Liverpool Road, N., clerk. The number of directors is not to be less than two nor more than five. The first are:—A. Morrison (chairman), B. Gee, and J. Cuthbert. Qualification, £100; remuneration as fixed by the company. Registered by Lumley & Lumley, 15, Old Jewry Chambers, E.C.

Harry W. Cox, Limited (57,703).—Registered June 8th, with capital £2,000 in £1 shares, to acquire and carry out business as an electrician, electrical and mechanical engineer, contractor, model maker, and manufacturer of electrical and scientific appliances, carried on by H. W. C. Cox at 10, 11 and 28, Cursitor Street, Chancery Lane, W.C. The subscribers (with one share each) are:—C. F. Leighton, Manorfield, St. Albans, gentleman; A. Greek, 41, Oakley Road, Canonbury, N., clerk; B. Aylward, 35, Brook Green, W., gentleman; F. R. Nutt, 17, Cornwall Cottages, Essex Road, N., electrician; H. W. C. Cox, 51, Cricketfield Road, Hackney Downs; E. F. C. Savory, 2, Clement's Inn, W.C., gentleman; Mrs. M. Cox, 51, Cricketfield Road, Hackney Downs. The number of directors is not to be less than three or more than five; H. W. C. Cox, B. Aylward, and C. F. Leighton. Qualification, £100; remuneration as fixed by the company. Registered office, 10 and 11, Cursitor Street, Chancery Lane, W.C.

Biograph and Mutoscope Company for France, Limited (57,708).—Registered June 9th, with capital £100,000 in £1 shares, to acquire certain inventions for the reproduction of objects in motion, and the French patent rights for the same, to adopt an agreement with A. Grove, J. S. Montagu, and J. W. Orde, and to carry on the business of mutoscope, biograph, and mutograph manufacturers, battery makers, tablet and diaphragm manufacturers, electricians, electrical, mechanical, and chemical engineers, iron and brass founders, &c. The subscribers (with one share each) are:—E. B. Koopman, 18, Great Winchester Street, E.C., director; T. N. A. Grove, J.P., 11, Hans Road, S.W.; J. S. Montagu, M.P., 29, Cornhill, E.C.; J. W. Orde, 29, Cornhill, E.C., gentleman; E. Baker, 29, Cornhill, E.C., secretary; N. P. A. Brady, 81, Cannon Street, E.C., gentleman; A. R. Roberts, 13, Walbrook, E.C., solicitor. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, 100 shares; remuneration, £1,200 per annum and a share in the profits, divisible. Registered office, 29, Cornhill, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Electric Traction Company, Limited (49,855).—This company's annual return was filed on May 7th, when 30,000 ordinary and 10,000 preference shares were taken up out of a capital of £600,000 in £10 shares. £10 per share has been called on the ordinary, and £6 10s. per share (including £2 10s. per share premium) has been called on the preference. £354,817 has been paid, £10,183 is in arrears, and £57 has been received in advance.

India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited (1,122 C).—This company's annual return was filed on May 27th, when 50,000 shares were taken up and paid for in full out of a capital of £812,000 in £10 shares.

Indo-European Telegraph Company, Limited (3,953).—This company's annual return was filed on May 10th, when 17,000 shares were taken up and paid for in full out of a capital of £450,000 in £25 shares.

London Platino-Brazilian Telegraph Company, Limited (12,093).—This company's annual return was filed on May 23rd, when 37,548 shares were taken up and paid for in full out of a capital of £400,000 in £10 shares.

Elmore's German and Austro-Hungarian Metal Company, Limited (32,457).—This company's annual return was filed on June 3rd. The capital is £162,981, divided into 50,000 pre-

ference shares of £2 each, and 62,981 ordinary shares of £1 each. All the ordinary and 22,275 preference have been taken up, and 25,000 ordinary are considered as paid. £1 per share has been called on the 37,981 ordinary, and £2 per share on the preference, and £82,531 has been paid. 1,730 shares have been forfeited, and 10,337 shares cancelled, and £22,131 12s. 10d. has been paid in respect thereof.

Oriental Telephone and Electric Company, Limited (40,691).—This company's annual return was filed on May 12th, when 171,504 shares were taken up out of a capital of £200,000 in £1 shares. 171,497 shares are considered as paid, and £7 has been received on the others.

Altrincham Electric Supply, Limited (40,795).—This company's annual return was filed on May 27th, when 25,000 shares were taken up and paid for in full out of a capital of £50,000 in £1 shares.

Rand Central Electric Works, Limited (43,712).—This company's annual return was filed on May 20th, when the capital of £300,000 in £1 shares was fully taken up. 25,000 shares are considered as paid, and £275,000 has been received on the others.

Electric Cycle Syndicate, Limited (36,227).—This company's annual return was filed on April 1st, when 2,827 shares were taken up out of a capital of £3,000 in £1 shares. 1,000 shares are considered as paid, and £1,742 10s. has been received on the others, leaving £84 10s. in arrears.

Electric Exploitation Company, Limited (40,256).—This company's annual return was filed on April 22nd, when 20,367 shares were taken up out of a capital of £25,000 in £1 shares. 20,000 are considered as paid, and £360 has been paid on the others, leaving £7 in arrears.

CITY NOTES.

Western Brazilian Telegraph Company.

The thirty-fifth ordinary general meeting of the above company was held on Thursday, June 9th, at Winchester House, Old Broad Street, Mr. W. S. Andrews presiding.

The Chairman, in moving the adoption of the report, said he was glad to say they were able to meet the shareholders under rather better auspices than had been the case for some little time back. There was an increase in the revenue and a decrease in the expenses. The revenue for the half-year had amounted to £72,332 9s. 10d., as compared with £71,315 12s. 2d., showing an increase of £1,116 17s. 8d., and that would have been rather more had it not been for special circumstances to which he would presently refer. With regard to the expenses, they were £37,774 1s. 11d., as compared with £38,160 19s. 4d., consequently there was a decrease of £386 17s. 5d. Dealing first with the expenses, there was a total increase of £1,211 under abstract A, but of that maintenance accounted for £750, and stores and new apparatus for another £524, and there was an increase of £400 under miscellaneous. The decreases in abstract A, were travelling, £300; and stationery and printing, £83; the net result being an increase of £1,211. Abstract B, which dealt with their shipping, was always a source of considerable anxiety with them, and he was very pleased to say that under that head there was a notable decrease, because in the period under review they dispensed with the services of the second ship that they had been obliged to employ previously—the *Buccaneer*—and the saving amounted to £3,477 15s. 5d., although their other ship, as a matter of fact, had to do all the same work, and did it very satisfactorily, of course, with an increased consumption of coal and other expenses. That saving of £3,477 he would have liked the shareholders to have had the immediate benefit of, but it had been partly absorbed by certain special expenses incurred in Buenos Ayres on account of the attack—which might have been rather a dangerous one for them—made under the guise of tariff changes. They had to defend themselves from that attack, and it was rather a costly defence. Then, in addition to that, they had maintenance and repair expenses, and new apparatus, which ran away with some £2,500 of that reduction, which they would otherwise have got the entire advantage of. In abstract C, out of the total increase of £167, £154 12s. was owing to arbitration expenses, so that was practically about the same. The result was that they were left with a decrease of expenses amounting to £386 17s., and he was glad to say that decrease did not end with the period under review, but it was going on and increasing, so that there was no doubt by-and-bye they would have a better tale to tell the shareholders with regard to the expenditure, even than they had that day. Dealing with the net revenue, there was the balance from last half-year, £3,867 15s. 2d.; there was the dividend on the shares in the Platino Company, £11,094—against none in the corresponding period—and the balance on their own working, after payment of expenses, amounted to £34,558 7s. 11d.—together, £49,520 3s. 1d. They had to deduct £8,060 8s. 4d. for interest on debentures and debenture stock; £2,159 12s. 4d. for sinking fund for the redemption of the new debentures, and, with £5,000 added to the reserve fund, they got a total of £15,220 0s. 8d., which left £34,300 2s. 5d. available. They proposed to declare a dividend of 6s. 9d. per share, and to carry forward £1,428 5s. 11d. to the current period. That distribution was equal to a dividend of 3¼ per cent. per annum, and consequently it was the best dividend that they had received since 1891, when it was at the rate of 4 per cent. That pointed to an improvement in their affairs which must be gratifying to all of them, but gratifying as was that comparison it did not end there. They not only paid more than double the dividend that they paid in the corresponding period which was 3s. per share, but the net revenue earned during the half year was more than double that earned in the six months ending June, 1896, and on this occasion they were able to pay more than double the dividend and add £5,000 to the reserve, instead of having to assist their smaller dividend as they did in 1896, by taking £7,500 out of the reserve. All they wanted now was a little revival in the trade of Brazil, and their position would be decidedly more satisfactory. The exchange had been 7⅞d. only as against 8⅞d., but, of course, under the new mode of collection, that was not so serious as it appeared. Still, under the new method, before fixing the rate of exchange for the coming three months, the Government took the average rates of exchange for the preceding period, and, of course, if the average for the preceding three months was higher than they got for the next three, when the rate had been fixed, they lost money. Strange to say, ever since that arrangement was made for the collection of the exchange, it had been going down, so that although the rate had been fixed at a certain point they had never actually got it, but something below it. At present the exchange was going up, and consequently their receipts were going up with it. The augmentation of the revenues of their company, and of those of the Platino, were continuing. Already they had reached a point in their revenue a good deal above the corresponding period, and therefore he hoped—he might almost say he was confident—that they would be able to tell the shareholders even a better story than the present when the current half-year's business came to be laid before them. No doubt they would have remarked that the new president-elect of the United States of Brazil had come over to this country to arrange important matters in connection with Brazil. There was no doubt that Brazil needed a period of rest and recuperation, and it was earnestly to be hoped that she might obtain it. When the great natural riches of the country were considered they had every reason to expect that, with a careful administration of the revenues, a very gratifying and prosperous result might yet be produced. He was sure they would all wish the president-elect every success in his patriotic efforts, and God speed in his important mission for the benefit of his magnificent country. There was one other question in the report which he could not say much upon. Undoubtedly the shareholders would have noticed that paragraph in which they stated that negotiations for closer working between their company and the Brazilian Submarine Telegraph Company had been in progress. Those negotiations were not completed yet. They were progressing satisfactorily and pretty actively, and they believed they would result successfully, and that the results would be welcome alike to the governments, the public, and the companies. Of course, nowadays it was necessary to do things which were agreeable all round, and not to shut one's eyes or direct them into a narrow focus. He would, therefore, ask them not to put any questions to him in reference to that subject, but if there were any other matters shareholders wished information upon he would be very happy to afford it them.

Lord Richard H. Browne seconded the motion for the adoption of the report and it was carried without discussion.

The retiring directors having been re-elected, Major Cotton, in moving the re-election of the auditors, said he thought they must congratulate the chairman and directors upon the improved state of affairs they had put before them, and upon the very hopeful prospects for the future. He hoped that the negotiations which were being carried on for closer working with the Brazilian Company might soon be brought to a satisfactory termination for the benefit of the shareholders especially.

The motion having been carried, the proceedings terminated with a vote of thanks to the chairman and directors.

British Thomson-Houston Company, Limited.

The third ordinary general meeting was held on Friday last at the offices of the company, Cannon Street.

Mr. E. A. Lazarus, the chairman of the company, presided, and in moving the adoption of the report, observed that their business had gone on very quickly during the year, and they had had to extend their offices and premises a good deal. With regard to the principal traction contracts now in hand, they had the city tramways of Dublin, Cork, which was also a lighting concern, the Central London Railway, Middlesbrough, Sheffield, Dudley-Stourbridge, and Oldham-Ashton. Those were the principal inclusive contracts, but they had a good deal of other business. They did not rely on patents for their success, but on the way in which they did their work. The industry, however, had been and was developing very quickly, and they had latterly found that a good many competitors were infringing their patents. They had spent about £100,000 on acquiring them, and they were therefore seriously considering whether it might not be worth something more to protect them.

Sir Thomas Thompson seconded the motion, which was adopted, and dividends of 10 per cent. for the year on the "A" and "B" shares were afterwards declared.

Elmore's German and Austro-Hungarian Metal Company, Limited.

The directors have been this week inviting applications for an issue of £60,000 6 per cent. debenture stock at par. The trustees are Lord Farrer, of Abinger, and Mr. J. R. Hollond. Applications were received for over £37,000 before the issue of the prospectus. The following table shows the increase in the value of the sales for the past three

years and the balances of the profit and loss account of the "Metall" Company for the same period:—

1895 sales	...	£17,052	12	3	...	Loss	...	£1,575	9	5
1896 sales	...	24,747	17	9	...	Profit	...	347	18	3
1897 sales	...	37,929	18	6	...	Profit	...	3,202	11	0

while the sum of £5,748 11s. 5d. was deducted from revenue by way of depreciation during the same period. The value of the sales for the present year to the 1st inst. shows an increase of 90 per cent. as compared with that for the same period last year. In 1897 the "Metall" Company was given a contract to supply the total requirements of the German Navy for a period of three years. This contract was, by arrangement, cancelled in April last, and a new one has been entered into, whereby the company is to supply all tubes over 1⅜ inch in diameter for the next two years, but at greatly enhanced prices. Notwithstanding the increased production, the company was in 1897, and is now, unable to accept even a moiety of the orders offered by the large shipyards and private customers. The output for 1897 was 411 tons; the new plant, now nearly completed, when fully at work, is estimated to produce 1,100 tons per annum. The list closed yesterday afternoon.

Callender's Cable and Construction Company.

The report of the directors for the year ended December 31st last, states that the accounts show a balance at the credit of profit and loss of £24,746, from which must be deducted interest on debentures, £4,050, appropriation for depreciation of machinery, plant, &c., £3,000, leaving an available balance of £17,696. The directors now propose to pay a dividend at the rate of 10 per cent. per annum (clear of income-tax), being 10s. per share, whereof 4s. was paid on October 31st, 1897, as an interim dividend, leaving 6s. per share to be paid now, absorbing £10,000, and a bonus of 2s. 6d. per share, absorbing £2,500, leaving £5,196 to be carried forward. The total payment for interest and bonus on account of 1897 will therefore be at the rate of 12½ per cent. per annum. The expenditure on buildings, plant, and machinery has proved beneficial to the business, and has enabled it to produce better and cheaper cables than at any time in the past. The plant and premises have been maintained in a thorough state of efficiency, and the cost not only of all repairs and maintenance, but of alterations and improvements, has been debited against the year's profits. Some of the shares held by the company have been disposed of, and others have necessarily been acquired in connection with the business. The present market value of the shares held exceeds by several thousand pounds the value shown in the balance sheet, but it is not proposed to deal with this excess at present. The business transacted in 1897 was again much larger than that in previous years, and the directors are glad to report that it continues to increase, and that the output of the factory during the last five months has exceeded their utmost expectations. Although extensive additions to plant, machinery, and buildings were made in 1897, it became evident towards the close of that year that still further additions were required to cope with the fast growing business, and that these must be on a much larger scale than heretofore. The land at Erith which the company owns had been utilised nearly to its full capacity, and was clearly insufficient for these extensions, and, after lengthy negotiations, the directors have succeeded in purchasing about 25 acres of freehold land adjoining the present factory, which will assure ample space for extensions for many years to come. The present capital is quite insufficient to enable the company to carry on their rapidly increasing business to the best advantage and to meet the cost of the necessary extensions of the works. It is therefore proposed to increase the capital by the creation of 20,000 preference shares of £5 each, and the requisite notice of an extraordinary general meeting has been given for the purpose. It is not contemplated to issue more than 10,000 of these shares at the present time, and these will be offered first to the existing shareholders.

The second annual general meeting of shareholders of the above company was held on Wednesday last at the offices, 90, Cannon Street, Mr. Henry Drake presiding. The Chairman, in moving the adoption of the report, said he hoped the shareholders would consider the accounts satisfactory. The directors were very well satisfied with the progress of the company. They had had a very prosperous year, and the figures in the balance sheet carried out that view. There were one or two items in the accounts to which he would call attention, as he thought they prove interesting. In the first place they would observe that they had spent £11,355 on enlargement of works and additional plant, which was in addition to the £2,985 written off the profits, for repairs and maintenance. In 1896 they spent nearly the same amount—£11,238. The next item he would call their attention to was that of cable drums, which stood at £2,803 as against £2,170 last year. That afforded a very fair indication of the increase of the business, because they used those drums for winding their cables on, and the amount stood at about one-third more than last year. The next item was stock in hand, which was only £1,200 more than last year. Then came expenditure on contracts in course of execution and sundry debtors, and there they had an increase of £26,000—that was to say, those two items, together, came to about £100,000 as against £74,000, which was a very satisfactory thing. Cash at the bank and bills receivable stood at £9,136 as against £15,229, which, he thought, showed that they were using their means as closely as they could. Shares in other companies stood at £6,603, as against £8,800. That arose in this way: they had sold shares that they held in 1896, and they had placed the money that they had received from that to the credit of that account. They had taken up a few more shares, rendered necessary in the course of their business, but they had not increased the value of the shares that they held; they had left them simply at the value that they stood in the last balance-sheet. The result was, that there was an undisclosed profit on these shares, probably amounting to about £10,000, but they did not wish to deal with that money until they had realised it. Coming to the profit and loss account, the balance to the credit of that account was £17,696, as against £13,507, which was an increase of £4,000. They proposed to pay 6s. a share, being the balance of 10s. per share dividend, which was 10 per cent. on the capital. That would take £10,000. They also proposed to pay a bonus of 2s. 6d. per share, which would absorb another £2,500, which would make a total distribution of 12½ per cent., leaving £5,196 to carry forward to next year's account. He hoped the shareholders would consider those results satisfactory. The business of the company had very largely increased, and that led him to refer to the proposed increase of capital, to which reference was made in the report. It was absolutely necessary that their works should be extended. At present they had not sufficient room to carry on the business they had in hand, or the work which they would in all probability get in the future. They had considered the question of extension for a long time, and at last they had had an opportunity of purchasing 25 acres of land adjoining their factory. It had no river frontage, but as they already had as much river frontage as they required, that was immaterial, and it enabled them to buy the land very cheaply. It only cost them about £130 an acre, which, for their purposes, was a very small sum indeed. There was a small quantity of land on the other side of their works for which they were in negotiation, and for which they were prepared to give £500 an acre, but when the 25 acres adjoining their own place was offered them, they thought it far better to buy it than a smaller site, where they would not be able to place so much space between their buildings. That, of course, brought him to the point of increased capital. Their present capital was quite insufficient, and therefore they had sent out notices for an extraordinary meeting to increase the capital by £100,000, and there was a statement made in the report on that matter which he wished to qualify. It was stated that it was not contemplated to issue more than £50,000 of that capital at the present time, but since the report was issued the directors had again gone carefully into the matter, and had come to the conclusion that they must issue the whole, probably extending the period of payment over a longer time than they would otherwise have done.

Lieut.-Colonel G. A. Elliot seconded the motion, and the report was adopted.

Mr. T. O. Callender, the managing director, addressed a few words to the shareholders as to the progress of the business, and said he was glad to say that, good as was their business in 1897, it was nothing to what they were doing now. Their only difficulty was to turn out the work, and not only did they want further working capital, but also they needed more plant and machinery. It was very likely that within the next two or three years the business they were at present doing might be doubled, and it might interest the shareholders to know that 90 per cent. of the company's business was with leading corporations throughout the country.

Subsequently an extraordinary meeting was held, when resolutions were passed authorising the directors, subject to the confirmation of another extraordinary meeting, to create £100,000 additional capital in preference shares of £5 each.

Replying to a question, the Chairman said the new capital would, in the first instance, be offered to the existing shareholders to the amount of their present holding.

Altrincham Electric Supply Company, Limited.—The balance-sheet shows a balance profit for the past year of £725. The company has several important contracts in hand.

City of London Electric Lighting Company.—The transfer books and register of holders of £400,000 5 per cent. debenture stock will be closed from 21st to 30th inst.

Electric and General Investment Company.—The transfer books will be closed from 13th to 28th inst, inclusive.

TRAFFIC RECEIPTS.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 10th, 1898, were £2,899 0s. 1d.; corresponding period, 1897, £3,365 1s. 5d.; decrease, £466 1s. 4d.

The City and South London Railway Company.—The receipts for the week ending June 12th, 1898, were £931; week ending June 13th, 1897, £880; increase, £51; total receipts for half-year, 1898, £24,558; corresponding period, 1897, £24,215; increase, £343.

The Dover Corporation Electric Tramways.—The receipts for the week ending June 11th, 1898, were £157 4s. 8d.; total receipts to June 11th, 1898, £2,698 15s. 9d.

The Dublin Southern District (Electric) Tramways Company.—The receipts for week ending Friday, June 10th, 1898, were £648 5s. 3d.; corresponding week last year, £920 8s.; decrease, £272 2s. 9d.; passengers carried, 97,778; corresponding week last year, 123,715; aggregate to date, £10,963 10s. 1d.; aggregate to date last year, £11,548 5s. 7d.; decrease to date, £584 15s. 6d.; mileage open, 8 miles.

The Liverpool Overhead Railway Company.—The receipts for the week ending June 12th, 1898, amounted to £1,482; corresponding week last year, £1,857; decrease, £375. 1897 includes Whit Monday.

The Western and Brasilian Telegraph Company, Limited.—The receipts for the week ending June 10th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brasilian Telegraph Company, Limited, were £2,850.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, June 8th.	Closing Quotation, June 15th.	Business done during week ended June 15th, 1898. Highest.	Lowest.
137,400*l*	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	7 — 8	7 — 8	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	93 — 96	93 — 96	...	...
923,960*l*	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	64 — 67	64 — 67	64½	64¼
3,038,020*l*	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	115 —116	116 —117	116½	115½
3,038,020*l*	Do. do. Deferred	Stock	...	...	...	15¾— 16¼	16¼— 16¾	16⅝	15⅝
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16	15½— 16	16⅛	15¹⁵⁄₁₆
75,000*l*	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	...	...	112 —116	112 —116	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¾— 3¼	2¾— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297*l*	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106½	106¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½%	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	6½— 7⅛	6½— 7⅛	7⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	14½— 15½	14½— 15½	14⅞	14⅜
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	10⅜	...
30,000*l*	Do. do. 4½ % Debs., Nos. 1 to 6,000	50	4½ %	4½ %	4½ %	103 —106%	103 —106%	...	...
60,710*l*	Direct United States Cable	20	2¼%	2½%	...	10½— 11	10½— 11	10⅞	10⁹⁄₁₆
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100—103	101 —104	...	...
400,000	Eastern Telegraph, Nos. 1 to 400,000	10	6½%	6½%	...	17 — 17½	17¼— 17⅜	17⁹⁄₁₆	17
70,000	Do. 6 % Cum. Pref.	10	6	6	...	18 — 19	18½— 19½	18⅝	18⅜
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	101 —104	101 —104	...	...
1,302,615*l*	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	124 —128	123 —127	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	17½— 18	17½— 18	17¹¹⁄₁₆	17⁹⁄₁₆
25,200*l*	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
100,500*l*	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	126 —129	126 —129	...	...
35,100*l*	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500*l*	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000*l*	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	101 —104	101 —104	...	...
200,000*l*	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	105 —108%	105 —108%	...	...
180,227	Globe Telegraph and Trust	10	4⅛%	4½%	4½%	11½— 12	11½— 12	11⅛	11¹⁄₁₆
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16¾— 17¼	16¾— 17¼	17⅛	16⅞
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	10 %	29 — 30	29 — 30	...	...
160,000*l*	Do. do. do. do. 5 % Debs.	100	5 %	5 %	5 %	100 —103	100 —103	...	...
97,000	Halifax and Bermuda Cable, 4½ % 1st. Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	98 —103	99 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	50 — 53	50 — 53	51½	50½
100,000*l*	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	108 —111	108 —111	...	...
28,000	Montevideo Telephone, 6 % Pref., Nos. 1 to 28,000	5	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	...	...
484,597	National Telephone, 1 to 484,597	5	5½%	5½%	6 %	5½— 5¾	5⅝— 5⅞	5¾	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 16	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5⅜	...
1,329,471*l*	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	101—106	101—106	104	103
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾	⅝— ¾	...	...
100,000*l*	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	8 — 9	8 — 9	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 —141	138	...
58,000	United River Plate Telephone	5	4 %	5 %	...	4 — 4½	4 — 4½	4⅜	...
146,733*l*	Do. do. 5 % Debs.	Stock	5 %	...	...	104 —107	104 —107	106¼	106
15,609	West African Telegraph, 7,501 to 23,109	10	4 %	*nil*	*nil*	3½— 4½	3½— 4½	...	...
213,400*l*	Do. do. 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	101	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½%	12 — 12½	11⅜— 12¼xd	12	11¹¹⁄₁₆
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7½— 8	7¼— 7¾xd	7⅜	...
33,129	Do. do. do. Def. Ord.	7½	1 %	*nil*	½%	4½— 4⅝	4⅜— 5xd	4⅝	4¹¹⁄₁₆
389,521	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	⅛%	1 %	¾%	½— ¾	½— ¾	11⁄16	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	7½— 7¾	7½— 8	7¹³⁄₁₆	7¾
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 — 7	5 — 7	...	...
80,000*l*	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
1,163,000$	Western Union of U.S. Telegraph, 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	105 —109	105 —110	...	...
160,100*l*	Do. do. do. 6 % Ster. Bonds	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	12 — 13	12 — 13	12¾	12⅝
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
26,000	*Chelsea Electricity Supply, Ord., Nos. 1 to 10,277	5	5 %	5 %	6 %	8½— 9½	8 — 9	8⅝	8½
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	115 —117	115 —117	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000	10	5 %	7 %	10 %	24½— 25½	26 — 27	27⅜	25¼
10,000	Do. Prov. Certs. Nos. 90,001 to 100,000 £5	10	...	...	...	16½— 17½	18 — 19	18⅝	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16½— 17½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	129 — 134	129 —134	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	*nil*	*nil*	*nil*	13 — 14	13 — 14	13¹³⁄₁₆	13
10,000	Do. do. do. Nos. 30,001 to 40,000 £4 paid.	10	...	...	...	6½— 7½	6½— 7½	7	6⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	15 — 16	14½— 15½	15	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400 £4 paid	5	...	...	...	3½— 4½	3½— 4½	...	...
10,000	House-to-House Electric Light Supply, Ord., 101 to 10,100	5	...	...	4 %	9 — 10	8½— 9½	9⅜	...
10,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	10½— 11½	10½— 11½	...	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15 — 16	15 — 16	16½	15⅜
220,000*l*	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	4½%	117 —121	117 —121	119½	118½
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	18 — 19	17½— 18½	...	...
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½%	10½%	14½%	16 — 17	16 — 17	16½	16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9½— 10½	9 — 10	9⅛	...
50,000	Do. do. 4 % Deb. Stock Red.	Stock	...	...	4 %	107 —110	107 —110	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2 — 2⅛	2 — 2⅛	2⅛	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	7 %	9 %	12 %	15½— 16½	15 — 16	16⅛	15⅝

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation June 8th.	Closing Quotation June 15th.	Business done during week ended June 15th, 1898. Highest.	Lowest.
30,000	British Electric Traction	10	...	...	...	15½ — 16	15¾ — 16¼	16⅛	15½
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 £4 pd. (issued at £2 10s. prem. all pd.)	10	...	...	...	7 — 8	7½ — 8	7⅞	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅞ — 2⅛	1¾ — 2	2	1¾
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2¼ — 2½	2⅛ — 2⅜	2 3/16	2⅛
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
19,894	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	9¾ — 10¼	10½	10⅛
129,179	Do. do. do. £6 paid	10	...	...	...	6 — 6½	5¾ — 6¼	...	...
59,254	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼ — 1⅜	1¼ — 1⅜	1½	1 7/16
67,680	Do. do. Def. do. £5 paid ...	...	...	...	...	4¼ — 4⅜	4¼ — 4⅜	...	...
630,000*l*	City and South London Railway	Stock	1 3/16 %	1 9/16 %	1⅞%	68 — 71	68 — 71	70	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £2 pd.	10	...	...	...	... ...	1¾ — 2¼	1⅝	2¼
82,850	Crompton & Co., 5 % 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	88 — 93	88 — 93	91¾	90
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅛%	...	2¼ — 2⅜	2¼ — 2⅜	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅛%	...	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	103 —105	103 —105	...	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	...	2⅝ — 2⅞	2½ — 2¾	...	...
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	...	...
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	106 —108	106 —108	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	21½ — 22½	21½ — 22½	22⅜	21¼
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	22	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	104½	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅝%	2⅞%	3¼%	10 7/16 — 10 9/16	10 7/16 — 10 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15¾ — 16¼	15¾ — 16¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	34 — 37	35 — 38	36	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	130 —133	124 —127	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.

House-to-House, 4½% Debentures of £100, 106—109.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 15—16; 1st Preference Cumulative 6%, £5 (fully paid), 8—8½. Debentures, 107—110. Dividend, 1897, on Ordinary Shares 10%.

London Electric Supply Corporation, £5 Ordinary, 3¾—4¼.

*T. Parker, £10 (fully paid), 15¼.

Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 8¼—8¾. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (June 2nd, 1898).

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1898.

ON THE NECESSITY FOR UNIFORMITY IN PLANT AND APPARATUS.*

By C. H. WORDINGHAM, Assoc.M.Inst.C.E., M.I.Mech.E., M.I.E.E., City Electrical Engineer, Manchester.

THE principles enunciated by Dr. John Hopkinson in his classical paper, on the cost of electric supply,† are now fully appreciated by the majority of supply engineers, municipal and others, but it is doubtful whether they recognise that their own field of labour is but one very small, indeed, insignificant, plot in the wide area to which these principles apply.

Manufacturers of all engineering products have to face the same problem, viz.:—the production of articles, the cost of which is made up of two items, one independent of the quantity sold, the other practically proportional to that quantity.

In the case of manufacturers, the standing charges comprise the establishment of the works, *i.e.*, the cost of land, buildings, engine power, machinery and tools, drawing office staff, patterns, &c.; the establishment of offices, and in many cases of showrooms, with staff of clerks, travellers, &c.; the holding of a stock to supply the demand without delay; while to these standing expenses must be added the salaries of a number of engineers, managers, &c., who must be ready to design the articles manufactured, and who must be kept up to date in the latest practice, often at great cost.

The running expenses are wages for labour, skilled and unskilled, fuel, oil, &c., for running the works, repairs to machine and other tools, raw material.

Probably no better example of high cost could be taken than the manufacture of submarine cables. In this case both items are greatly exaggerated. A large amount of very expensive machinery occupying great space, and extensive buildings, has to be provided and kept in good order, to be used perhaps once in the year, and when it is required it frequently happens that the work is of an urgent nature, and manufacturing has to be kept going day and night for a few weeks, necessitating overtime and high rates of wages, together with excessive wear and tear of plant, while the cost is still further augmented by the fact that the cable is probably of a special size and design.

Now let us examine into the means by which the cost of manufacture may be reduced. Assuming that all that is possible has been done to economise by the choice of a site where land is cheap, by suppression of superfluous cost in the erection of buildings, by skilful design to avoid unnecessary handling of goods, by the absence of display in offices, &c., what remains to enable the manufacturer to reduce his costs? One thing pre-eminently, restriction of the number of types and sizes of the articles produced. To produce, say, a dynamo machine or an engine, a number of calculations have to be made, then a series of drawings must be prepared, next the patterns, and finally the tools. All this means large expense, and, if only one article is made, the whole cost has to be charged to that article, and this standing cost may completely swamp by comparison the cost for material and labour. Whereas, if a thousand such articles were required, the fixed cost, being divided amongst them all, would be only one-thousandth part of what it was in the case of one. By limiting the number of patterns, it becomes possible to devote more time and attention to perfecting the design and the tools necessary for the manufacture, hence higher efficiency is gained in conjunction with reduced costs, for, though the provision of the tools requires a slight addition to the standing cost, it is quite inappreciable when divided among the number of articles sold, and there is a corresponding saving effected in labour.

The subject as a whole is a very wide one, but this paper must necessarily be confined to the particular case of electric supply stations, and the author hopes to be able to show that, even limited to this small area, the question is of great importance.

At present, every engineer in designing a station, seems to think it incumbent upon him to have something different in his station to that in every other. One fixes upon some peculiar declared pressure, involving special designs for every lamp, motor, radiator, or other consuming device that is to be attached to the circuit. Another wants alternating current of special periodicity, or transformers of an unusual capacity, or in a case of some unheard-of shape. Another

* Read June 9th.

† See Dr. John Hopkinson's paper on "The Cost of Electric Supply," read before the Junior Engineering Society, on November 4th, 1892.

wants extra large boilers, or dynamos of a capacity different to any stock size. Another requires cables of a size necessitating strands of some odd gauge of wire. No doubt this is not wholly intentional, but arises partly from want of thought, partly from ignorance, and partly, it is to be feared, from a feeling that manufacturers are a kind of inferior race, who cannot possibly know as much as the engineer, and who must do as he tells them. Now, it is essential to success, both mechanically and financially, that the engineer and manufacturer should mutually strive to secure it; the manufacturer must endeavour to carry out the engineer's objects, and the engineer must subordinate the details of his scheme to the convenience of the manufacturer. No man can know everything thoroughly, and it must be admitted that a manufacturer, who devotes his whole time and energy to the production of a particular class of machinery or apparatus, must know more about that particular class than the engineer with whom it is but one item out of the many comprising his whole scheme. Only those men, whose standing in the profession is assured, dare to admit and recognise this, the second-rate men fear that their doing so will be construed into a confession of ignorance or incompetency.

As an evidence of the want of uniformity now existing, I have made inquiries as to the practice as regards certain points, and through the courtesy of the engineers running the stations, have obtained the following information. The particulars relate to 109 stations, in 46 of which continuous current is employed, in 55 alternating, and in eight both alternating and continuous.

First as regards declared pressure, the following table gives the number of stations and the various pressures declared:—

Table A.—Declared Pressures.

Declared pressures.	Continuous current.	Alternating current.
50 Volts.	...	1
50—100 „	...	2
84—103 „	...	1
90—100 „	1	...
100 „	3	29
100—200 „	10	10
100—105 „	1	1
102 „	..	2
102—205 „	...	2
105 „	2	1
105—210 „	3	1
107—214 „	1	...
110 „	3	2
110—220 „	8	1
113 „	1	...
115—230 „	1	...
150 „	3	...
200 „	2	4
210 „	1	...
210—420 „	1	...
220 „	4	1
220—440 „	3	...
230 „	3	...
Total	51	58

In addition to the above, a few stations give special pressures for special reasons. One station varies its pressure according as the transformer is made by one or other of two manufacturers. Another, which normally supplies at 100 volts, supplies at 102 by special arrangement with a "Lunatic Asylum." (!) A third supplies at 113 volts, but naively recommends 110-volt lamps. Apparently this station is not run on the same lines as those in which the declared pressure is "102½ volts."

Incidentally, it may be remarked that the permission given by the Board of Trade to vary the declared pressure in different districts is practically never taken advantage of, while as against this, one station, in defiance of all Board of Trade regulations, boldly declares a pressure of 420 volts.

The next point of importance in which the practice differs is the question of periodicity in alternating stations. The periodicities are set forth in the following table:—

Table B.—Periodicities.

3 at 40	periods per second.
7 „ 50	„ „
1 „ 58	„ „
6 „ 60	„ „
1 „ 67·5	„ „
1 „ 74	„ „
3 „ 75	„ „
1 „ 77—80	„ „
1 „ 77	„ „
2 „ 80	„ „
6 „ 83	„ „
1 „ 83·5	„ „
1 „ 83—100	„ „
1 „ 87	„ „
1 „ 87·5	„ „
2 „ 90	„ „
2 „ 93	„ „
17 „ 100	„ „
1 „ 125	„ „
58	

The size and pressure of the generators is the next point of interest. It did not appear worth while to tabulate the pressures generated in low pressure stations as the declared pressure is a sufficient indication of the pressures used. As regards the high pressure generators, however, the following table shows the pressures generated:—

Table C.—High Pressures Generated.

Pressure.	Continuous.	Alternating.
Volts.	No. of stations.	No. of stations.
1,000	3	3
1,000—1,050	1	...
1,400	1	...
1,800	...	1
1,800—2,000	1	...
2,000	1	35
2,000—2,100	...	5
2,000—2,200	...	3
2,000—2,500	...	1
2,050	...	1
2,100	...	4
2,110	...	1
2,200	...	1
2,400	...	1
2,500	...	2
3,000	...	1
Total ...	7	59

The size of generator is very important, and here again there is a most extrordinary discrepancy in the sizes employed. These are tabulated in Table D. Without entering into the number of machines, which do not very greatly affect the question, the following sizes are in use:—

Table D.—Size of Generating Unit.

Continuous.		Alternating.		
10 kw.	80 kw.	20 kw.	62 kw.	150 kw.
12 „	88 „	22 „	66 „	154 „
15 „	90 „	23 „	70 „	160 „
20 „	100 „	25 „	72 „	165 „
25 „	112 „	26 „	75 „	175 „
27 „	120 „	30 „	80 „	180 „
28 „	125 „	32 „	81 „	187 „
30 „	140 „	33 „	82 „	200 „
33 „	150 „	35 „	84 „	210 „
37 „	160 „	36 „	85 „	222 „
40 „	200 „	37 „	88 „	225 „
50 „	210 „	40 „	90 „	250 „
52 „	212 „	44 „	100 „	260 „
60 „	250 „	45 „	110 „	300 „
64 „	300 „	50 „	120 „	350 „
65 „	350 „	55 „	125 „	360 „
66 „	400 „	57 „	130 „	380 „
70 „	600 „	58 „	135 „	390 „
75 „	1,500 „	60 „	140 „	—

Inquiries as to whether standard sizes of mains, meters, &c., were employed, showed that in many instances such is not the case, the sizes being chosen haphazard according to requirements.

The above figures will serve to show the utterly chaotic state of central station practice as regards standardisation in this country at the present time, and very little consideration is necessary to show that the difficulties to be coped with by manufacturers in consequence must be enormous, and that, for the reasons stated at the beginning of this paper, the price of plant and apparatus to users must be very largely augmented, without there being any corresponding additional profit to manufacturers. The additional cost is in fact pure waste, and benefits nobody.

No doubt it is inevitable, in the early stages of any industry, that there should be great diversity of practice, indeed, it is desirable that things should not become stereotyped until the best has been discovered, but we have surely now arrived at a time when we can make up our minds on such subjects as those enumerated above, and it is of vital importance that the matter should be settled soon, for each new station that is to be built perpetuates its own set of quantities.

The most important point of all is the declared pressure, for this affects every consuming device as well as generators, or transformers if used. While it should be so fixed as to admit of as economical distribution as possible, it should not involve a loss to the consumer in wasteful resistance, or in enhanced price for lamps specially fragile or difficult to manufacture.

The author ventures to think that, taken all round, 100 volts and multiples thereof is the most convenient pressure, and the one most likely to meet with general acceptance. In the first place, it is that most largely used at the present time, and it meets the conditions named above, since two ordinary arc lamps, or one enclosed, can be made to burn steadily at 100 volts, the waste in resistance being reduced to a minimum, while for the first multiple, viz:—200 volts, there is little difficulty in obtaining single incandescent lamps. Moreover, it gives a convenient pressure across the outer conductors, a pressure suitable for tramway working, while allowing a good margin for loss on low pressure feeders, without necessitating a higher pressure at the generating station or transforming station, than 500 volts, which is the limit of low pressure fixed by the Board

of Trade. Incidentally, 100 volts is very convenient for mental calculations, and for meters when ampere-hour instruments are employed.

In passing, it may be remarked that a good deal of doubt appears to exist as to the exact meaning of the Board of Trade definition of low pressure, viz., whether 500 volts is the limit at the station, or at the network end of the feeder, and an authoritative interpretation of this would be very acceptable.

Other directions in which standardisation is necessary may be mentioned here, viz, the adoption of standard candle-powers for incandescent lamps. It would appear that no more than four sizes below 100 candle-power are really necessary. A little consideration will show that, quite apart from the question of manufacture, the limiting of the number of sizes would enormously reduce the amount of stock that has to be held, and hence a large amount of capital uselessly locked up would be set free.

The number of sizes of arc lamps might very well be reduced. Three would suffice for all ordinary purposes. If this were done, not only would the cost of production be greatly lessened, but the ease of replacement of damaged and worn out parts, and the cheapening of carbons, together with convenience in obtaining them, would be a great gain.

As regards motors, it is probably not worth while to make anything smaller than 2 horse-power, whatever it is intended to drive, except perhaps in the case of ventilating fans. The bulk of the demand will probably be for motors under 25 horse-power, and three sizes between this and 2 horse-power should suffice.

So long as a supply of alternating current continues to be given to consumers, the question of periodicity will affect the stations concerned nearly as greatly as does the question of declared pressure, and it is therefore as important that some definite understanding should be come to. The variation at present, as will be seen from the table, is as great as or even greater than in the case of pressure.

The question of periodicity will always be an important one, as there can be little doubt that two or three-phase current will be generated in many stations in the future, though probably it will not be supplied to consumers.

Next in order of importance perhaps is the size of generating unit in the station. It was recently necessary for the author to go into this matter somewhat carefully, and he was astonished to find at what an early period in the development of a central station it becomes possible and safe to employ large units. There are practically four factors governing the choice of the unit of the plant. They are

(1) The initial capacity of the station.
(2) The probable ultimate capacity.
(3) The steps by which it is permissible to increase the capital expenditure.
(4) The percentage safe overload of the plant.

It may be mentioned here, that, in the author's opinion, it is preferable to have reserve plant in the shape of machines with considerable margin of possible overload beyond maximum economical load than in the form of spare machines, for the latter are only of use in cases of actual breakdown, while, in the former case, the reserve is always ready to be called into play at a moment's notice, and there is no delay due to having to start up another machine in case of sudden demand, whether from a running machine having to be switched out or from an abrupt change in weather. Further than this, the same amount of reserve can be attained more economically.

The conditions to be fulfilled then, are, that if any one machine break down, the remaining machine shall not be overloaded more than a definite amount, say, 33 per cent., 25 per cent., or 20 per cent. If the last-named figure be adopted, this means that the first installation of plant must consist of six machines of equal capacity; their size will depend on the initial capacity of the station. When extensions have to be made, the increment of plant will depend upon the increment of capital permissible. The condition that any one unit may break down without overloading the plant 20 per cent. allows of either one, two, or more machines being added. The amount of increase of capital will be a minimum if only one machine be put down, but this course is open to the serious objection that it means a number of machines all differing in size after the first six, hence absence of interchangeability of plant, and an unsightly station. It would appear most convenient to increase the plant by pairs of machines, since this gives a symmetrical arrangement, allows of reduction of spare parts, and renders the machines convenient multiples of one another. Time does not admit of a particular case being worked out, but if this be done, it will be seen that a large size is soon reached, and after a certain point the rule cannot be carried out, as it leads to engines of impracticable size. It then becomes necessary to add each time one or more machines of the same size. It would be a matter of great interest to learn from engine and dynamo builders what is the upper limit of size of generator.

It will thus be seen that we begin with six machines with parts interchangeable, and finish with a certain number of machines depending on the size of the station, also having the parts interchangeable, and between we have a number of machines of varying sizes. In very large stations put down on a sufficiently generous scale, all the units may be of the same size, but the author maintains that the initial number should not be less than that number which allows of one breaking down without overloading the remainder more than the specified amount, and it cannot be considered safe to put down one or two large machines to begin with, and to trust to good workmanship and design to avoid mishap.

On the above principles it should not be a difficult matter to work out a series of machines which will provide for stations of all ranks, and yet be limited in number.

Next may be considered the question of mains, both as regards the conductor and the insulation. It is greatly to be desired that only a few sizes of conductor should be decided upon. The author has endeavoured to show elsewhere* that of necessity the size of main required in a given street is largely a matter of guesswork, hence it should not be a difficult matter to agree upon standard sizes that may be such that they can be made up from ordinary S.W.G. wires. If this were done, a manufacturer could afford to stock a great deal of wire, and one source of delay in delivery would be avoided.

Again, it surely should be possible to settle upon standard tests for dielectrics of different kinds for given pressures, and if this were accomplished, manufacturers could stock cable actually ready for delivery. The advantage of this will be fully appreciated by central station engineers, for, instead of each one having to store for his own requirements, he would be able to order from stock, and save the expense of cable stores and their attendants, besides being able to meet unlooked for extensions at short notice, while the aggregate stock, and therefore the capital locked up, would be much less than if there were a number of separate stores.

We next come to accessories such as service cables, transformers (in the case of alternating supply), main fuses, meters, maximum recorders, meter boards, &c. Here again the cry must be standardise. Find out the best all round pattern of each, and keep to it. Have as few sizes as possible. Arrange your parts so that they shall come in if extensions take place so that the work may not have to be redone. In his own practice, the author has endeavoured to carry out these principles, and he has to a great extent succeeded, but it would be tedious to enter into the details.

It is of little use for one, or even many, individuals to standardise unless there be co-operation. It will probably be said, all admit that uniformity of plant is desirable, and you are but labouring to prove that which is evident. How do you propose that this desirable end should be achieved? The author replies that there is but one way, and that is by settling upon certain standards that will be acceptable to the majority of those concerned, and this can only be done by thrashing out the subject by a committee thoroughly representative of all classes interested.

This Association is representative of a section of one section only, viz, the Municipal section of users of plant, and it is not therefore competent to deal with the matter by itself. The Institution of Electrical Engineers, the mother of all British Electrical Societies and Associations, is the proper organisation to which the matter should be referred, and it will doubtless be a matter of satisfaction to the members of the Association to learn that our Council has already approached the Institution with a view to this, and a committee has been appointed by them to thoroughly go into the question.

The recommendations of the committee cannot fail to carry great weight, and, if the matter be properly taken up uniformity will soon be secured, for it will be found that the firms not making standard plant could not compete with those that did, and users with fads would find them too expensive to indulge.

It may be thought that such a system should be international, but it is to be feared that the difficulties of securing the desired end would be such as to make it impracticable, and it would result in the matter being indefinitely postponed.

In conclusion, the author trusts that the various points he has alluded to will be thoroughly discussed, and that some practical suggestions for the guidance of the committee referred to may be forthcoming.

APPROPRIATION OF PROFITS AND REPAYMENT OF LOANS.

By Bailie Wm. Maclay, Convener of Electricity Committee, Glasgow Corporation.

In every department of municipal work—however technical it may be—there always arises the question of finance. As the proverb has it, "Money makes the mare to go," and even an electricity committee must study ways and means. It would be a comparatively easy matter for a wealthy corporation to erect extensive buildings and put down an installation of the finest machinery and plant—it may be regardless of expense—but it is a different and a more difficult thing to generate current at a price that will commend its use to the majority of the community, either as an illuminant or a motor power, or both. An old friend of mine was at one time manager of the Home Farm, associated with one of the largest iron industries in this country. Many a time I wondered why he left the employment of that firm. I had it all explained to me one day by one of his contemporaries. Mr. Johnstone, he said, kept his farm in splendid order. Everything was done in the very best style, but he could not make it pay so he had to go. Fortunately for me, the subject of my paper does not compel me to deal with deficits—only with profits. As a rule profits can easily be disposed of. It is a fact, in the experience of most men that profits are more easily distributed than secured. But when a corporation does come to hold something like a monopoly, it ought to make profits, or perhaps I should rather say, ought to have a surplus every year. Those surpluses having been secured, the question naturally arises what is to be done with them. In the city of Glasgow we have no difficulty with that. We believe in letting "every herring hang by its own head." In other words, the Corporation allows each of our commercial departments to dispose of any surplus that may result from a successful year's business. We recognise the fact that not one of these depart-

* See his paper on "The Distribution of Electrical Energy," read before the Northern Society of Electrical Engineers, on November 8th, 1897.

ments exists to make profits—as is the case with a private commercial concern—but that rather it has been called into existence for the benefit of the community as a whole. This matter seems to be viewed rather differently in England, and had that not been the case, perhaps I should not have written this paper. Let us take Manchester as a typical example. At the end of their financial year they showed a surplus of £40,000 in the gas department, which was transferred to city fund account, presumably for the relief of taxation. Now it may be said that "it is as broad as it is long," and what is taken out of the one pocket is simply put into the other, the community being no poorer by the transfer. I am inclined to dispute that. Take, by way of illustration, our gas department, whose business is one of the largest of its kind in the three kingdoms. Annually we carbonise something like 600,000 tons of coal, and we supply gas to all consumers in the city of Glasgow, the important burghs of Govan, Partick, &c., and nearly every district within a radius of seven or eight miles from the centre of the city. Now let us suppose that every ratepayer uses our gas, but they all do not use this illuminant alike, and in an exact proportion to their rental, which is the basis of municipal assessment. Some of our people use gas only as an illuminant. Others, again, turn it to account in stoves for heating purposes as well as for lighting, whilst a third class use it not only for light and heat but also as a motor power. Having no differential charge in Glasgow, the large consumer would therefore pay away far more, probably, than he received back in the form of reduced taxation, whilst a small consumer might get a rebate of taxation out of keeping with his gas consumption, and that at the expense of the larger consumer. This is neither fair nor equitable, and would not be tolerated in our city. We contend that what has been taken from a gas consumer in excess of the cost of production and distribution should be given back to him at once and directly through the department in the form of a reduced charge in the immediate future. This meets all the wants of the case, and inflicts a hardship on no one.

But this is not my principal nor my strongest argument in favour of the Glasgow system of appropriation of profits. We hold that it is a sound policy to place as few restrictions on business as possible, especially in these days of keen competition. We maintain that if any of our commercial departments, originated solely for the good of the people as a whole, is compelled to keep the price of anything above the cost of production and distribution, then a restriction, an artificial and arbitrary restriction is placed upon the business of that committee. Is it fair or just to that particular committee? Is it fair or encouraging to the engineer or superintendent who is largely responsible for the prosperity of the undertaking? I say that it is not, and that every committee should in this respect be unfettered. It is true that it is very creditable to the gas department of Manchester that they should be able to supply gas at a moderate price, and at the same time hand over £40,000 annually to the city fund. We, in Glasgow, think that it is at least as creditable to supply gas to the community at, perhaps, as low a price as obtains in the three kingdoms, although we should not give a farthing to the city fund for the relief of taxation. Further, our Electricity Committee have faith in the proposition that by reducing the price of current they will increase the demand, and an increased demand will enable them to reduce the price still further, until it reaches the irreducible minimum. The two things are closely associated, and in fact, co-related. You cannot well have the one without the other. That leads us to the conclusion that every department—and especially the electrical department—ought to have a free hand in this respect, in order to demonstrate to the public that it is doing its best to provide, and provide successfully, for the wants of the people, and the best evidence of this is to be found in a low charge for current rather than in a continuous large surplus to be appropriated by other departments at the end of each year. Last year, on a turnover of £30,000, our Electricity Committee had a profit of £18,000. When disposing of this surplus, we first of all set aside £2,770 as an extra depreciation on the John Street and Miller Street stations, where the plant and machinery were old and somewhat obsolete, having been acquired from a private firm, when we received our provisional order. Next, we debited £1,500 against renewals on meters, and £1,000 for probable renewals of ordinary plant and machinery in the Waterloo Street station. We further appropriated about £5,500 of our large surplus for ordinary depreciation on our buildings, plant, and machinery, mains and cables, making in all £10,705 10s. for depreciation and renewals in our stations. The balance of our surplus of £18,000, amounting to £7,293, we disposed of as follows:—A sum of £4,300 was absorbed by interest on capital, £1,466 was placed to the credit of the sinking fund. This left a net balance of £1,527, which was carried forward to the credit of next year's account. This, gentlemen, is how we dispose of a surplus in Glasgow. Every penny of it was appropriated for the good of this department, and this department only, and we maintain that the citizens benefited quite as much as if the bulk of it had been devoted to the relief of our municipal taxation.

I now come to speak of the other branch of my subject—"the repayment of loans." It would take up too much of your valuable time were I to examine and compare the indebtedness of Glasgow with the obligations of other municipalities, or enlarge on their various systems of repayment. It may suffice that I treat of the indebtedness of our own municipality and of our sinking funds, allowing each of you to make his own comparisons and draw his own conclusions. In order to make my figures exact and complete, I shall deal with the year ending May 31st, 1897, being the latest financial year of the Corporation of Glasgow. At that date the liabilities of our Corporation, including gas and water annuities, and the debt of the common good department, amounted to £8,748,652, and our assets to £11,596,384, thus showing a clear balance in favour of the municipality to the extent of £2,847,732.

But having stated the amount of our indebtedness, the question naturally arises: How are these liabilities to be discharged? Let me say, before I proceed further, that all our money for departmental purposes is borrowed through the loans fund, at the head of which is an excellent financier. This is a useful institution, which unites and keeps in touch all the departments of the Corporation. Should any committee have more money than they can profitably use, they lend it to the loans fund, whereupon the loans department either pays off debt or lends the amount to some other department of the Corporation. In this way, we never have to go outside to seek for investments. Temporary loans on revenue account must be repaid within a reasonable time, and out of the revenue of the year in which they were borrowed. If any one of our departments promotes new undertakings requiring further capital expenditure, then its borrowing powers must be increased by Act of Parliament, and the money secured from the investing public by an issue of stock or otherwise. In the case of a temporary loan, the lending committee is credited with the current rate of interest, whilst the borrowing committee is debited with the average rate payable on the loans.

Our debts we liquidate in the customary way, by means of the sale of property, and the sinking fund and the rates vary according to the nature and character of each respective undertaking. At May 31st, 1897, our police department was still owing £1,549,254, but the sinking funds being all calculated on the maximum amount originally borrowed, this sum will be quickly reduced, and finally disappear altogether.

Under the heading of police department we include the following: Public health and permanent paviour work, the sinking fund for which is at the rate of 5 per cent. The rate for sewage purification works is fixed at 1¾ per cent. For general police purposes, sewer construction, and street improvements purposes it is 2½ per cent, whilst for rebuilding of bridges and payment of county road debts the rate stands at 2 per cent. In 48 or 49 years after to-day this large debt will be extinguished altogether. Many of us in Glasgow will not live to see this "consummation devoutly to be wished," but whilst the individual citizen dies, the corporation lives on and flourishes in perennial youth.

In our water supply department, the balance of loan debt unpaid stood at £2,784,148 in 1897. At the departmental minimum rate of sinking fund 1½ per cent., this balance will be absolutely wiped out in 66 years hence. It is true that we are contracting new and large obligations, but we must leave something to be paid by posterity, as they will inherit from us, perhaps, the finest water supply in the kingdom.

I shall now say a word about the gas and electricity departments. Our electricity committee was a sub-committee of the gas committee until the November before last. It was then created a separate and independent committee unless in the matter of finance. We shall therefore have to treat the indebtedness and the sinking funds of the two as one joint obligation. In 1897, the joint indebtedness might be taken to represent £1,127,495.

These I have enumerated are the heaviest liabilities of the Corporation, and I think I need not go further into detail. The markets department, with its sinking fund and—in its case—surplus profits, should extinguish its present debt in 28 years, which is something like 3 per cent. per annum overhead. The parks and galleries departments and the municipal buildings have a minimum rate of 1 per cent. with accumulations for their sinking funds. The parks debt will be repaid in 49 years and the municipal buildings in 56 years. The city improvement's department has a loan debt of £1,246,256. The debt is reduced by sales of property and surplus income. The sinking fund does not come into operation till the last property is sold, and our tramways pay off their obligation of £516,556 by a sinking fund at the rate of 2 per cent., which if accumulated at 3 per cent. will pay off the debt in 30 years.

I have thus given you the particulars of the manner in which we repay our loans. The system seems to have commended itself to our fellow-citizens, and our finance has been approved by capitalists all over the kingdom. Were evidence of this wanting, it must be found in the very low rate of interest we pay on our loans. On our last issue of stock it is only 2½ per cent., and on our temporary loans the average rate is as low as £1 11s. 9d., whilst our promissory notes have been readily taken up by London financiers at even 1½ per cent. and 1 per cent.

Gentlemen, our motto of old was "Let Glasgow flourish by the preaching of the Word." To-day Glasgow flourishes also by the low rate of interest on capital expenditure.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The Design of Electric Railway Motors for Rapid Acceleration. By Prof. Charles A. Carus-Wilson, Member. Read May 26th, 1898.

(*Concluded from page* 827.)

If single-reduction gearing is used, the largest ratio of v *to* d is limited by the number of teeth in the pinion for a driving wheel of given diameter. For example, let us take a driving wheel 33 inches in diameter. If the clearance between the casing of the gear wheel and the level of the rail is limited to $4\frac{8}{8}$ths of an inch, we cannot get more than 67 teeth in the gear wheel. If the least number of teeth in the pinion is 14, the velocity ratio is limited to 4·78, and the ratio of v to d is limited to 0·145. These dimensions and numbers are taken from the standard street railway equipment made by the General Electric Company.

In our example, if the driving wheels were 33 inches in diameter, the velocity ratio required to get the best results would be 7·15. This would be impossible with single-reduction spur gearing. We should therefore have to use a smaller value of v than the best.

If the series-parallel controller is used, the maximum current from the line at the moment of starting is reduced by one-half. Since the current per motor is the same as with the parallel controller, the acceleration will be unaltered. The motors can be held in series until the speed is 5·7 f.p.s.; the result then is to reduce very nearly by one-half the expenditure of energy due to heat. In estimating the energy required to cover any distance, we may generally assume that the effect of series-parallel control is to halve the heat lost.

As an illustration of the application of these principles to the heavier class of railway work we may take the Metropolitan Elevated Railroad of Chicago. Particulars of this railway have been given by Mr. M. H. Gerry, and may be found in a paper published in the *Proceedings of the American Institute of Electrical Engineers* for 1897.

The rolling stock consists of motor cars and passenger cars. The former measure 47 feet in length, and weigh 62,000 lbs. when fully loaded. They are mounted on locomotive trucks, with driving wheels 33 inches in diameter, the velocity ratio being 3·18. One truck of each motor car is equipped with two motors.

The passenger cars are 47 feet in length, having trucks fitted with 30-inch wheels, and weigh 46,000 lbs. when fully loaded. Trains of two, three, and four cars are made up according to the demands of the traffic at different hours. We shall consider a train of one motor car and three passenger cars, weighing in all 90 tons. We shall take the case of two stations separated by a distance of 2,500 feet of level track, and consider first the effect of the period during which the brakes are being put on.

If the distance covered during the period of retardation bears to the time occupied the same ratio as the whole distance to the whole time, *i.e.*, if the mean speed during retardation is equal to the schedule speed—the value of $\frac{M\,v}{d}$ will be independent of the time during which the brakes are on. For this quantity depends only on the ratio of t to D, and by our supposition this is unaltered by the length of the retardation period. The final speed will therefore be unaltered, and hence the energy expended in accelerating will be independent of the rapidity of stopping.

Again, the accelerating current varies as $\frac{D^2}{t^2}$, hence it will decrease as t increases; *i.e.*, the accelerating current will decrease with the time occupied in braking. But the work done in heating will be nearly the same, since C_a constitutes by far the greater proportion of the whole starting current.

The energy spent in overcoming friction, however, will increase with the distance during which the motors are working, but the amount of increase will generally be a small proportion of the whole energy thus spent. If, then, the mean speed of retardation is equal to the schedule speed, we may determine the time occupied and the distance covered during the retardation period simply with reference to the ability of the brakes to stop the train. In the case before us we shall allow 20 seconds and 500 feet for retardation, leaving 2,000 feet to be covered in 80 seconds.

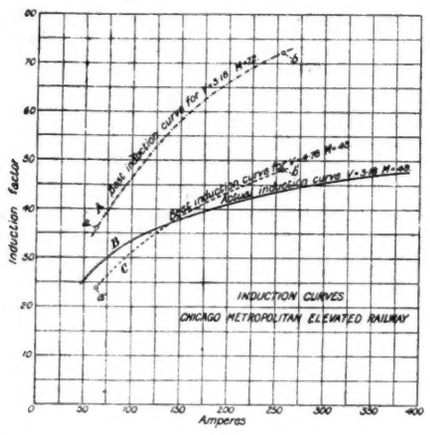

Fig. 9.

The tension of the line is 500 volts. If the drop at full speed is limited to 5 volts, we find from equation 15 that $\frac{M\,v}{d}$ must be 3·46.

If we adopt the existing values of v and d, we get M = 35·9.

From the results of tests made on this line, the retarding forces at 15 miles an hour, including gear friction, amount to 13·6 lbs. per ton of load, or 614 lbs. horizontally per motor. Hence the current at full speed will be 63 amperes, and each motor must have a resistance of 0·0795 ohm. The train resistance, excluding gear losses, amounted to 450 lbs. per motor.

We have thus found one point on the induction curve, namely, M = 35·9 for 63 amperes. In fig. 9 horizontal ordinates represent current, and vertical ordinates values of M. Take a point, a, giving = 35·9 for 63 amperes.

The accelerating current is found from equation 16 to be 226 amperes. If the induction factor at the start is twice that at full speed, the current then required for friction is only 31·5 amperes, so that the total current at starting must be 257 amperes, and the corresponding induction factor 72. This gives us a second point on the induction curve, and is plotted at b in the figure. We shall suppose that A is the best curve that can be obtained passing through the given points.

The diagrams of current and acceleration with motors having A as their induction curve are given in figs. 10 and 11, and are drawn in full lines. The time taken to cover 2,000 feet is 78 seconds, the saving of two seconds being due to the series winding. Full speed is 37·3 f.p.s., but is not reached, the highest speed being 33·5 f.p.s., or 23·6 miles an hour. The initial acceleration is 1·27 f.p.s. per second.

The induction curve for the motors actually used is given at B in fig. 9, and the curves of acceleration and current for these motors are shown in figs. 10 and 11 by dotted lines. The brakes were applied at the end of 77 seconds, when 1,930 feet had been covered; and the

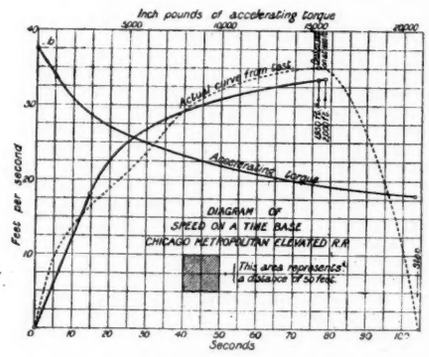

Fig. 10.

remaining distance of 570 feet, making up the total of 2,500 feet, was covered in 27 seconds, making the whole time 104 seconds.

The irregularities in the current-curve are the result of the uneven handling of the controller. The motors take 380 amperes each at the moment of starting, and are allowed to speed up in series for 10 seconds, after the starting rheostat is all out. When thrown into parallel the current per motor is 330 amperes, or 660 from the line. More careful manipulation of the controller would have effected a better start.

We have already seen that the force of a motor may be conveniently expressed as the product of the current and the corresponding induction factor. Since the ordinates in a diagram giving the induction curve represent current and induction factor, a curve of equal force is a hyperbola. In fig. 9 the point b represents an induction factor of 72 for a current of 257 amperes; in other words, the force factor required to start up with an acceleration of 1·27 f.p.s. per second is 18·5 kilodynes. If we draw a hyperbola through the point b, it will cut the induction curve B at a point giving the current that the motors in actual use must take in order to get an acceleration of 1·27 f.p.s. per second. The current thus found is 390 amperes. An inspection of the acceleration curves in fig. 10 shows that the acceleration obtained in the test is rather greater than that obtained by calculation, while the current is 380 amperes. The experimental curve, however, is somewhat irregular, and the agreement is as close as might be expected.

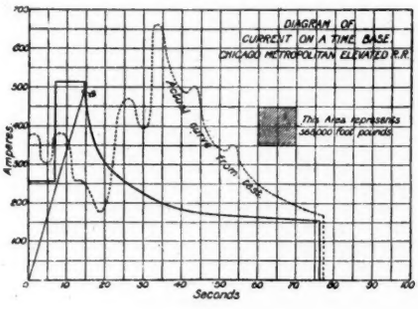

Fig. 11.

The effect of the form of the induction curve B on the current-curve is clearly shown in fig. 11. The maximum current from the line is 28 per cent., and the maximum current per motor 48 per cent., greater than it need be, while the expenditure of energy in the form of heat is 4·6 times what it would be if curve A had been used.

The force factor required to drive the train at full speed is given by the product of 63 and 35·9, namely, 2·26 kilodynes. If we draw a hyperbola through the point a in fig. 9, it will cut curve B at a point giving the current taken by the actual motors when running at

full speed, and it will also give us their maximum speed. This will be nearly inversely proportional to the minimum induction factor, and we see that it will be nearly 45 f.p.s., or 30·6 miles an hour.

It does not follow that the highest speeds actually attained in the two cases will be in the ratio of the minimum induction factors, because the maximum speed is not reached, but we see that the expenditure of energy in acceleration will be greater with the lower induction curve. The values for the kinetic energy in the two cases are 380×10^4, and 350×10^4 foot-pounds. The following table gives the expenditure of energy, expressed in foot-pounds, for a distance of 1,930 feet:—

	Total energy. From test.	Calculated.
For acceleration	380×10^4	350×10^4
For train resistance*	174×10^4	174×10^4
For gear loss, at 85 per cent. mechanical efficiency ...	98×10^4	92×10^4
For C^2 R loss	311×10^4†	67×10^4
	963×10^4	683×10^4

* $900 \times 1{,}930$.

† Obtained by deducting the previous amounts from the total expenditure, as found by integrating the current-curve.

The greatest induction factor in the motors actually used is 48. If we take this as the limiting value of M, we see that we must increase the velocity ratio in the proportion of 48 to 72 to get the best results. In fig. 9, curve C has been obtained by taking each vertical ordinate this proportion of the corresponding ordinate of curve A. If, then, we make the motors with this induction curve, they will work with the same economy as those with curve A, provided that the velocity ratio is increased in the proportion of 48 to 72—*i.e.*, from 3·18 to 4·78.

We are thus able to make a clearer comparison between the two motors. The new curve crosses the actual induction curve, but gives higher values of M for large currents and lower values for small currents. The changes that would have to be made to give the best results are: First, the velocity ratio should be increased from 3·18 to 4·78; second, the air-gap should be increased in width so that the induction curve may pass through the point a'; third, the section of the iron in the magnetic circuit should be increased so that the curve may pass through the point b'.

The economy of working under these conditions may be expressed best in terms of the work done per ton-mile, the distance, of course, including that during which the brakes are on. The energy expended may be conveniently stated in watt-hours.

Thus, in the example we have been considering, the economy attainable with induction curve C is 60·5 watt-hours per ton-mile. We here assume that the velocity ratio is limited to 4·78. With a maximum induction factor of 48 the highest possible economy is obtained with a velocity ratio of 9·75; the heat loss is then reduced to 17×10^4 foot-pounds, and the economy becomes 56 watt-hours per ton-mile. An equally good result could be attained with a maximum M of 72 and a velocity ratio of 6·50. The economy actually obtained with curve B is 85·1 watt-hours per ton-mile.

We may here inquire what would be the economy if the specification had insisted on a gearless equipment. To get the highest economy—*i.e.*, 56 watt-hours per ton-mile—the product $M v$ must be 468 for driving wheels 33 inches in diameter. If $v = 1$, the induction factor must be 468—a value much beyond the practical limit. To comply with the conditions as to time and distance, the minimum induction factor would have to be 114; if we take the maximum induction factor twice this value, we get the maximum M equal to 228, and a heat loss of 72×10^4 foot-pounds.

Since we have now dispensed with gearing, we can reduce the item in the table of energy expenditure due to gear loss. Assuming 95 per cent. mechanical efficiency, this becomes 31×10^4 foot-pounds; hence the economy is 55·5 watt-hours per ton-mile, the current for maximum and minimum induction factors remaining the same.

It is, however, unusual to find the maximum induction factor twice the minimum induction factor in motors of this size; a ratio of 1·5 to 1 is more usual. If we take 171 as the maximum value of M, the heat loss is increased from 72×10^4 to 162×10^4 foot-pounds, and the economy of working is 63·4 watt-hours per ton-mile. Thus with geared motors the expenditure of energy is about 5 per cent. less than with gearless motors of four times the weight.

The expenditure of energy per ton-mile may be reduced if the track, instead of being level throughout the whole distance, is provided with down grades at the station exits.

The best results would be attained if the train could actually start on the down grade. This, however, is impracticable; but the train should be brought to a standstill as near the top of the grade as possible in order to get the full advantage of the grade.

Let us suppose that the centre of gravity of the train moves through 150 feet before coming to the top of the grade, and that the force of gravity acts on the whole train throughout the length of the grade, which we shall take to be 300 feet with a fall of 9 feet.

The energy due to the train falling through a vertical distance of 9 feet is 181×10^4 foot-pounds; but this does not represent the gain due to the grade, for the final speed has been increased from 33·5 to 35·5 feet per second, giving an increased expenditure for kinetic energy of 43×10^4 foot-pounds: the difference represents the benefit due to the grade, and is 138×10^4 foot-pounds. With this arrangement there is a gain of about 6 seconds in the time of covering 1,930 feet. We might, then, have taken a larger value of t in our original calculations, relying on the gain in time due to the grade to reduce the time to that specified.

If, then, we take 82 instead of 76 seconds for a distance of 1,930 feet, the kinetic energy would be reduced to 162×10^4 foot-pounds, the C^2 R loss to 47×10^4 foot-pounds, and the gear loss to 60×10^4 foot-pounds; giving a total of 466×10^4 foot-pounds, and an economy of 39·4 watt-hours per ton-mile. The grade thus effects a saving of about 33 per cent. of energy with the geared motor, but only 28 per cent. with the gearless motor.

The results are summarised in the following table. The energy expended is expressed in terms of a unit of 10,000 foot-pounds. The distance is 1,930 feet throughout, and the weight of the train is 90 tons. In each case we suppose that the minimum value of M is the best possible—*i.e.*, that the expenditure of energy in accelerating is a minimum.

	Track: Level.	Level.	Level.	Level.	8% Grade.	3% Grade.
Maximum M	48	72	468	171	48	171
Velocity ratio ...	4·78	6·48	1	1	4·78	1
Kinetic energy	350	350	350	350	162	162
Train resistance ...	174	174	174	174	174	174
Torque loss	92	92	31	31	60	18
C^2 R loss	67	17	17	162	47	162
Total energy	683	533	572	717	443	516
Watt-hours per ton-mile	60·5	56·0	50·6	63·4	39·4	45·6

PHYSICAL SOCIETY.

Ordinary Meeting, June 10th, 1898.

Mr. Shelford Bidwell, President, in the Chair.

Dr. S. P. Thompson described and exhibited a model illustrating Max Meyer's theory of Audition.

Max Meyer abandons the audition theory of Helmholtz, and contends that analysis takes place in the ear otherwise than by resonance of the Corti organ. Imagine a jointed system, like a hand, to be oscillated from one end, *i.e.*, from the finger-tips. A small motion affects only the top joints, but a large motion affects the whole structure. Such a structure is the membrane of the inner ear. It widens towards one end, and is effectively damped by the contained liquid. Wave motions of different amplitudes run along it to different distances before they are extinguished; these distances are recorded by nerves, and are thereby communicated to the Corti organ. In the model, the compound wave to be analysed is cut out on the edge of a disc of zinc, so that, as the disc revolves, the motions are communicated to a framework. If the frame is thus moved through more than a certain distance, a displacement occurs which sets a second frame in motion, and so on to a third and fourth. The depth to which the motion penetrates is indicated by a series of glow lamps connected electrically to the frames.

Prof. Ayrton said it had for some time past occurred to him, when considering the way in which an expert telegraph clerk reads siphon-recorder signals on a long cable, that it might be possible to analyse waves without the supposition of a resonating apparatus. The clerk interprets not so much the motions to one side or other of the zero line, as the rate of change of velocity, *i.e.*, the acceleration of the siphon. This had been recognised in the design of those relays for long cables, where the lever makes contact when the received current exceeds a certain value, and breaks contact when the current falls below a certain minimum. Messrs. Siemens had adopted a relay in which the lever was carried on the suspended coil of a D'Arsonval galvanometer by a pivot with a small amount of friction. If contact was made, the coil could, nevertheless, continue in a given direction. If that direction altered, contact was immediately broken, and the lever passed over to the opposite stop, thereby reversing the local circuit. It was possible that, in the process of hearing, something akin to this took place, the ear behaving as a mechanism responsive, not by resonance to the complete waves, but by its sensitiveness to changes of direction of the received impulses.

Dr. S. P. Thompson thought that a mechanism similar to the relay described by Prof. Ayrton was contained in the telautograph of Elisha Gray; it was a "Prony" mechanism. In the acoustical problem the ear was probably sensitive to abrupt changes of shape in the waves as well as to reversals. In the case of mistuned octaves, something is heard that suggests "revolving" in the ear, indicating a cyclic change. In this regard, it was necessary to take into account the phase relations as well as the relative intensities of the component tones.

Mr. E. H. Barton then read a paper on the "Attenuation of Electric Waves Along a Line of Negligible Leakage."

It forms a sequel to a paper communicated to the Physical Society and printed in their *Proceedings* of December, 1897, and January, 1898. Shortly after the publication of the earlier results, Mr. Oliver Heaviside drew attention to Lord Rayleigh's high frequency formula for the "effective resistance" of wires to alternating currents, and suggested that the formula might be approximately applicable to the case; but he thought the experimental value of the attenuation would be considerably higher than the one derived from calculations. Mr. Barton here repeats the work, with special precautions as to the mode of insulating the parallel copper wires through which the wave-train proceeds. The value of the attenuation constant deduced from these experiments is 0·000013. By applying Lord Rayleigh's formula for the effective resistance of the circuit, and using this value in Mr. Heaviside's expression for the attenuation, the calculated constant is 0·0000062. To account for the discrepancy, the author points out that the effective resistance formula was originally developed for a wire placed at a considerable distance from other parts of the circuit, and for currents following the harmonic law. Whereas, in the experiments, the conditions are (1), wires 1·5 mm. diameter, only

8 cm. apart; and (2), the waves are propagated in the form of a damped train, with the large end leading; they are extinguished after ten or a dozen vibrations.

Mr. Oliver Heaviside (communicated) pointed out that, as there was human interest in error, it might be worth mentioning that at first it was supposed the previous experiments of Dr. Barton made the index of the alternation factor to be six times that of the long-wave theory for simple periodic waves. And it was hard to account for so large a discrepancy. The discovery of an error in the figures reduced the result from six to two. The small depth of the surface-layer of effective conduction, and the distance apart of the wires, seemed now to make it improbable that Dr. Barton's first reason, (1), was adequate to account for the doubling of resistances. The second, (2), was, of course, a substantial reason for increased resistance. A third one, Mr. Heaviside suggested, was the external resistance at the boundary of the waves. A combination of the second and third reasons, with a little of the first, might account for most of the extra attenuations observed, and, if more was wanted, one could "*try the K R law.*"

Mr. Appleyard said it was rather to be regretted that in all the experiments the distance between the wires had been the same, *i.e.*, 8 cms. By taking a few different values, (1) might have been checked. Lord Rayleigh's formula for the effective-resistance, involved the square root of the magnetic permeability of the wires. The author had, throughout, used copper, a paramagnetic metal, and had assumed $\mu=1$. It would be of advantage to try other metals.

Mr. Barton, in reply, said he would make further experiments with the two conductors at different distances apart, and he would also try iron wires. With iron, the thickness of the surface-layer of the effective conductor was about one-thirteenth that of copper. Iron should therefore give a greater value of the attenuation than copper.

LEGAL.

The New Motive Power Syndicate.

Testing Guittari's Patent.

Mr. Justice Bigham and a common jury had before them on Thursday and Friday, the 9th and 10th inst., in the Queen's Bench Division, an action brought by Sir Samuel Canning and Mr. Tom E. Gatehouse, consulting engineers, against the New Motive Power Syndicate, Limited, in which it was sought to recover 75 guineas, balance of account for tests, and a report upon Guittari's patent mixture for generating steam in boilers, and which ultimately resulted in a verdict for plaintiffs for the full amount. Defendants counter-claimed for damage alleged to have occurred to their boilers.

The counsel engaged in the case were:—For plaintiffs, Mr. McCall, Q.C., Mr. Macaskie, and Mr. Howard Spensley (instructed by Mr. J. E. Lickfold); for defendants, Mr. Tindal Atkinson, Q.C., and Mr. A. B. Shaw (instructed by Messrs. Robinson & Stannard).

Mr. McCall, in opening the case, stated that the plaintiffs were requested by defendants, who were interested in a certain patent, to test and report upon it. They did so, and now said that they were entitled to the sum claimed, which was the balance due to them. The main question to be decided was, whether or not plaintiffs had carried out the work they were employed to do. The substance of the patent was that by a mixture of carbonic acid gas and Dutch liquid with water in a boiler, Mr. Guittari claimed the motive power would be increased, and steam would be generated more rapidly, besides which there would be an enormous saving of fuel. Defendants, who were interested in the invention, were anxious to obtain a report from a firm of leading engineers like the plaintiffs, with the ultimate object of placing it before the public. Therefore on July 23rd last year, Mr. Bale, one of the directors of the defendant syndicate, wrote to Sir Samuel Canning on the subject of tests, and the fee for that and the report thereon was fixed at 150 guineas, half of which was paid at the time the arrangement was entered into. The tests took place on July 29th and August 2nd and 4th last year at the defendant's works, when an engine was supplied with steam from two boilers all constructed by Messrs. Davey, Paxman & Co. On August 2nd, one boiler was supplied with Guittari's patent, and on the 4th the other with pure water. The results were taken, and would be put before the Court. The substance of the tests was that Mr. Gatehouse and the other seven or eight gentlemen present with him, who constituted his staff, came to the conclusion that the results obtained from Guittari's mixture were no better than those obtained from plain water, and plaintiffs reported accordingly. Mr. Bale objected to the way the tests had been carried out, and then refused to accept the report or to pay the money due.

Mr. T. E. Gatehouse, A.M.I.C.E., M.I.M.E., Editor of the Electrical Review, &c, Mr. W. H. Booth, Member American Soc. C.E., a former inspector of the Manchester Steam Users Association, Sir Samuel Canning, M.I.C.E., Mr. J. Christie, engineer to the Brixton Electric Lighting Station, and a certificated chief-engineer of the Mercantile Marine, Mr. Webster, for some time chief draughtsman and assistant to Mr. Bryan Donkin, and Mr. W. H. Massey, engineer to Her Majesty the Queen, who had also made tests, were then examined at considerable length, and tabulated statements showing the results of the tests were put into Court.

Mr. Tindal Atkinson, in addressing the jury for the defendants, said Guittari's patent consisted of a secret mixture which made the water extremely volatile, so that it gave off steam with a much less consumption of fuel than would be required by plain water. Plaintiffs were duly consulted as to proposed experiments, which should have consisted of a series of practical and exhaustive trials before the practical utility of the process was arrived at. Upon a previous report made by the plaintiffs to another gentleman, a syndicate was formed, and £1,500 was subscribed by them for the purpose of carrying into effect, and rendering the process a popular success. Before they asked the public to subscribe, they were very anxious to be satisfied beyond all possibility of doubt of its actual value. They were entitled to have the very best information, through the means of exhaustive trials, which Sir Samuel Canning had assured them would occupy at least 10 days. Instead of that, only two days were occupied in the trials, which were unfair in every respect, and hence the present action.

Mr. A. J. Bale, one of the directors in the defendant syndicate, was then called, and he bore out the statement of Mr. Tindal Atkinson. The plaintiffs agreed, he said, to make the trials in such a manner as to test the points included in a previous trial of Guittari's patented process made by the syndicate's consulting engineer, and they did not do so. Moreover, the stoker provided by plaintiffs was not competent, and the firing was inefficiently done.

In cross-examination, Witness was asked whether there were any letters, from the beginning to the end, in which defendants said that the tests were not sufficiently prolonged.

His Lordship: It is quite clear that there are none.

Witness said he made a protest against the way in which the whole thing was done. He admitted that he saw nothing wrong in the stoking by Guittari personally. He did not take the trouble to see whether the proper weight of coal was supplied during the tests.

What do you say about the blower being used. Supposing the atmospheric conditions on August 4th were worse than on the 2nd, do you say they ought not to be allowed to use artificial draught in order to equalise the conditions?—It would be quite contrary to anything that I required. They ought to have reduced the load under which the engine was running.

Where is Mr. Guittari now?—He is on the Continent.

Was he asked to come and assist this syndicate?—Yes.

And he declined to come?—Yes.

His Lordship: He is behaving badly to you, then?—I daresay he is.

Another Mr. Bale was called next, and having said that he bore no relationship to the last witness, stated that he was an engineer of 28 years' experience. With regard to the tests, he admitted he was not present, but from what had come to his knowledge he would say that if they were making tests with chemicals or with the water only, and the arrangement was that they should be carried out under identically the same conditions, they should have been so carried out. He had been on trials with engines and boilers for the Royal Navy, and in no case were they allowed to use forced draught when the test was with natural draught. In the present case he should say that these were not proper tests.

His Lordship: Supposing you wanted to get the tests done as soon as possible, would it be reasonable to use the blower and get the draught similar to the natural draught?—I might if I was requested to do it, but I should not consider it fair.

Cross-examined by Mr. McCall, Witness said he did not know that the consumption of coal on the day when the blower was not used, and on the day it was, was almost identically the same.

Mr. John Humes, consulting engineer to the syndicate, said he was present at the tests, and on one of the days the stoker got his fire in such a bad condition that he ran away. Then Guittari himself stoked. Witness had known cases where boilers were seriously injured by the use of the blower. The intense heat produced by a larger volume of air being drawn into the fire was more like a blow-pipe action than anything else.

His Lordship: But the blower is a very common thing, is it not?—Yes, if used with discretion, but in this case it was not. To show what an intense heat there was in the boiler I may say that for 12 feet the iron chimney must have been very nearly red hot, for it was all scaled, and the expansion through the heat of the chimney broke one of the stays. At the end of the test in this case the plaintiffs left the boiler and I went and opened the fire-door and saw the water streaming down, with very little fire in the box, and nearly all clinker. I should say that the value of the boiler after the test was depreciated quite £25.

Cross-examined by Mr. McCall, Witness said he considered the use of the blower had very little effect on the consumption of coal.

His Lordship: Has the syndicate sold this process yet?—No, I believe not.

Have they had any other experiments made except that which was made by plaintiffs?—No.

So you cannot say at present whether the process is worth anything or not?—No.

Mr. McCall, in replying upon the evidence, said that what the syndicate desired was a good report, and they could not get it. They wanted one which would have enabled them to pass off to the public the invention which they had bought from Guittari. Finding they could not obtain it, they immediately found fault, and objected to what they had practically ordered, and had honestly been given them. They had transferred the process from one syndicate to another—what for, the learned counsel admitted that he could not say—and Mr. Bale and his co-adventurers again started with the matter. Plaintiffs could not conscientiously give a report to the effect that Guittari's patent showed a great saving. Guittari had now gone away, preferring Belgium to this country, and would not now assist the syndicate. The process was one which they could not sell, could not use, and could not get a report proving the alleged value of it, and were therefore anxious to avoid paying plaintiffs their fee. Had the report pointed out that the process was of advantage, defendants would not have resisted payment, but on the contrary, a big company might have been floated by this time, and the members of the syndicate would have put into their pockets a considerable sum of money.

In summing up, his Lordship said the question the jury had to decide in this case was whether the plaintiffs, who were suing for certain money promised for certain services, did their work in a proper and conscientious manner. If they did, they were entitled to be paid the balance; while if they did not they would not be entitled to it, but, on the other hand, would be bound to refund the 75 guineas which had already been handed to them. If a skilled person was employed to do a job he must do it with the skill which a person in his particular business would be expected to do it. If anyone employed a doctor to cure one of a disease, the doctor must bring, in the discharge of his duty, the skill which was expected, not of an ordinary layman, but of a doctor. Just in the same way when a civil engineer had to conduct a test or an experiment, he must do it with such skill as a civil engineer was supposed to have, and not with the skill only of a more ordinary individual who could not deal with it. Therefore, the question here, and the only question, was, did the plaintiffs bring to bear upon the tests of August 2nd and 4th the skill which the defendants had a right to expect from them. Defendants complained that such skill had not been brought to bear. When work was done and the person for whom it was done refused to pay for it, alleging that it was not done in the way he was entitled to expect, it was always as well to look at all the circumstances to see whether there was any other motive likely to influence him to make complaints. Some people, after having ordered a thing to be made for them, did not like the thing—not because it was badly made, but they did not like it, and found all sorts of excuses. Now the jury had better consider what, in this case, the plaintiffs wanted, and whether they liked it when they got it. The defendants were the New Motive Power Syndicate, Limited, and had apparently bought the process of Mr. Guittari, whom they had not seen in Court during the hearing of the case. It was described as a process by which, if one mixed with water a mysterious compound, and then put it in a boiler, much better results could be obtained than with water only. A syndicate, which he would call No. 1 syndicate, bought the process, and raised amongst themselves £4,000, with the object of making certain tests to see whether the mixture was really worth what was claimed of it. That £4,000 seemed to have been spent; how, his Lordship did not know. Then it was thought wise to sell the process, and it was proposed that somebody else would come in and find more money; consequently, syndicate No. 2 was formed, the object from the very beginning being that the proper thing to do was to sell it to the public—that was to say, to form a public company. Before they could hope to do that, however, they must get from a good firm of engineers, who possessed a good name, a favourable report, which would have been subsequently printed in a prospectus, and probably he (His Lordship) and the jury might, in due course, have found some of the prospectuses upon their breakfast tables one morning inviting them to subscribe. Defendants wanted that favourable report from a good firm, which he believed the plaintiffs to be, and for a favourable report they were willing to pay a certain price. There had been one report in the past, made to a member of syndicate No. 1, and the attention of the jury ought to be called to it, for it might be of some importance. It was made in December, 1896, by Sir Samuel Canning and Mr. Gatehouse, who, after dealing with the process, wrote the following:—"At the same time we think from the result of our trials that there is sufficient promise in the Guittari method to warrant a further expenditure to allow of a thoroughly practical and exhaustive series of experiments with an engine and boiler of reasonable horse-power." Bearing that in mind, counsel for the defence had indicated that the tests which formed the subject of this action were not sufficient. Well, the jury could put such value upon that as they thought proper. Following the course of events, it appeared that after they received the first report from Sir Samuel Canning, they approached him and his partner again, and further tests were arranged, which were supposed to be under as nearly the same conditions as possible, otherwise the whole thing failed. The first of the tests took place on August 2nd, and was substantially under Guittari's control, for the stoker, a man named Steele, who should have attended to the firing, under the pretext that he was frightened through having a number of Italians round him, left his work, and Guittari raked out the fire, remade it, and stoked till the end of the trial. It was important that that fact should be borne in mind, and that once they got the result of the Guittari experiment they could from scientific books ascertain fairly well whether the process was satisfactory or not. It was suggested by the plaintiffs that as soon as the result of the test with Guittari's mixture, Guittari himself stoking, was seen by Mr. Humes and Mr. Bale, who represented the defendants, they saw at once that they were not likely to get a report which would be of any marketable value to them. The only report which would have any commercial value to them was a favourable one. The Guittari test having been made, it did not appear that any objection was taken by defendants, except that it was not long enough, the objection being based upon what Sir Samuel Canning wrote in December, 1896, to an entirely different party, as to "exhaustive tests;" and certainly that objection was not made until plaintiffs asked for the balance of the fee agreed upon. With reference to the second test, on August 4th, and the conditions not being proper according to the defendants, there was no doubt contradictory evidence as to who did the stoking in the earlier part of the day; but his Lordship thought that did not matter. The real objection to that test was, that the blower was occasionally used to keep up the draught through the furnace. Well, a blower was a common appliance for the purpose of increasing and regulating the draught. Apparently there were conditions of the atmosphere where the draught was not so good at one time as at another, and sometimes the blower was used. Now, who put the blower there? The plaintiffs did not. It was part of the machinery which they found there when they made the test. What was it there for, unless it was to be used as occasion required? Did the jury think that Sir Samuel Canning and Mr. Gatehouse, and the people they employed used the blower unfairly? Why should they? They had no object in making an unfair or a wrong report. They said that they used the blower in such a way as to compensate for the difference in the atmosphere between the first test day and the second. No doubt there were changes in the character of the draught; it rose and fell, and had to be regulated as the changes occurred. But the real question in the case was this, was the work properly done? There had been a volume of evidence on one side that, notwithstanding the use of the blower the tests were properly carried out. A large number of witnesses testified to that, while, on the other hand, the defendants had called Mr. Humes, who said that in his opinion the test was not a fair and proper one. With regard to the report which plaintiffs prepared, his Lordship said he could not assist the jury very much as to that. He had it, but they had not seen it themselves. It was a very long report and had been handed up to him. Plaintiffs sent it to defendants in September, the month following the tests, and defendants at once said to them: "Take it away, we won't look at it, and we certainly won't pay you for it." Mr. McCall, plaintiffs' counsel, had suggested that the reason defendants refused to have it and pay for it was that they knew very well it was not favourable; and it might be that Mr. McCall's suggestion was right, and that the real reason was that it was not the sort of report the syndicate required. If the jury were of opinion that plaintiffs did their work in a proper and skillful way they need not be afraid to give them a verdict entitling them to the balance of their contract money. If, on the other hand, the jury came to the conclusion that they were neglectful, and did not go about their work as properly skilled men ought to have gone, by all means say so, and let them be made to give back to defendants the half of the fee which they had already paid, together with the sum which was claimed for damage done to the boilers, which was said to have occurred through the excessive use of the blower. That damage was laid at £25, which, to his Lordship's mind, seemed extraordinary. However, if the jury agreed to that figure, let them by all means allow it.

The jury considered for two or three minutes, when the foreman said they found a verdict for the plaintiffs for £78 15s., and also on the counterclaim.

Judgment was entered accordingly, with costs.

THE TELEPHONE INQUIRY.

(*Continued from page* 818.)

Mr. Hanbury presided on Thursday last week over a further sitting of the Telephone Committee.

Major-General Webber, Past President of the Institution of Electrical Engineers, said he had a considerable experience with regard to telegraphy. In 1867 he was deputed to examine the Prussian telegraphs, and made a report on that subject, and in 1870 he was instructed to take charge of a military contingent placed at the disposal of the Post Office, partly to assist in the instruction and maintenance of telegraphs, and partly to train soldiers for military purposes. In 1879 he left the Post Office, and having had experience of the earlier telephones, was asked to become a director of the Bell & Edison Telephone Company.

The Chairman: The information we want in the first place is as to the possibility of cheapening the present telephone service. Will you explain to us the defects and the cause of the high price of the present arrangement?—I would like to combine my answer under two heads. One is that a large amount of interest has to be paid on the capital expended on the system existent in this country, as was given in evidence by Mr. Forbes before the Committee presided over by Mr. Morley. That makes it clear that the rates cannot be reduced to anything like what is found in other countries. That, I think, is the prime reason why we have not got cheap telephony in the United Kingdom.

How far would that apply to the way the Post Office works them?—That comes under the other head, and is the cost of the construction of the plant. In 1870 the Post Office established a rate of charges for private wires in connection with telegraphy. I have always regarded these rates, which are more or less continued in connection with private purposes, as being almost prohibitive, and has made the telegraph and telephone only accessible to the rich. Owing to the cost of construction of telegraphic lines, and the same thing applies to telephonic lines, and owing to the heavy charges which have to be added, I am not prepared to say these rates are unfair, unless the Post Office are prepared as they are in the case of the Press to give special facilities.

Continuing, Witness said that in towns it cost more to lay wires underground than overhead, and the underground wires were laid more generally in England than abroad. He did not think that it was a distinct advantage to have underground wires unless the wires were very heavy. In all towns it was recognised as the right thing to have a metallic system, and that increased the weight. Before Mr. Morley's Committee he showed that wires laid in the City of London, estimated by Mr. Preece to cost £55, did not cost more than £15 or £18. It was cheaper to lay wires in the country than in a town.

As to the cost of working a system. Does the cost increase very much when you have very large exchanges?—That is a question which, I think, only those who have had the management of large

exchanges, such as the Paris exchange, and the large exchanges in America can give an answer to. I am not competent, as I have never had charge of a very large exchange. I do not think it is very great, one way or the other.

Questioned by the CHAIRMAN as to how it would be possible to cheapen the telephone service and bring it into greater use, WITNESS said that they had had 28 years of telegraphy in charge of a public department in which everything was worked on business lines, and attention paid to the minutest details. It appeared to him that the National Telephone Company had had an example before them to try and vie with the Post Office in accuracy and minute attention to details and efficiency, but they had overlooked that which was attended to in other countries, viz., the day-by-day wants of the people. He was afraid, however, that he must admit that London must be dealt with differently from other parts of the country. What he meant by London was 300 square miles. Things had gone too far in London really to make any change. In a paper which he read before the Society of Arts in 1895, he showed the way to solve the difficulty, which was to provide a system for those who wished to communicate all over London at one rate, and provide a system for those who wanted to communicate within a given area. Every day that became more difficult in London, and three years ago he urged that the Post Office should take it over. He would have the regional system in London. At present he believed there were 11,000 subscribers in London to the National Telephone Company, and they all had communication with each other. He considered that there were two markets, so to speak, for the telephone. There were the people who wanted the use of the telephone over the whole area, and those who wanted it for their daily wants. He supposed why the company had not supplied the latter demand was the difficulty of wayleaves and the disinclination to bring down the charges. What he meant by the daily wants of the people was the facilities which should be given for a lady to speak to her tradesmen or her doctor. He would divide London into 11 areas, making the City and a certain district round it one area by itself, with a high subscription. The minimum subscription should be applied to a system of speaking within a given area.

Does the present service of the National Telephone Company lead to an increased cost of plant?—I think that London was never originally laid out except by myself, and that was in 1880, when I allowed for 200,000 subscribers and the length of lines.

So the cheapness would not come in there. Where does the cheapness come in?—The cheapness would be to the subscriber for facilities which the undertakers would provide by giving minimum facilities at a minimum rate. It is not right that if I wish to speak in Kensington I should pay the same rate as those who wish to speak all over London.

You bring in a large number of additional subscribers; what would that mean in the way of additional plant?—It would depend entirely on the number of people who wished to come in on the smaller system. That you could not find out until the scheme was before the public.

Do you argue that the larger the number of subscribers the cost per subscriber would be reduced?—The actual cost of inter-communication would be much reduced.

As I understand, your complaint is that the National Telephone Company serve at the present moment a particular class; that is, the rich commercial class, and the rate of subscription is high; but you think a proper telephonic service ought to cater for other classes, to come down to small tradesmen, for instance. I understand that it is said on one hand that the cost of working the telephone service actually increases very rapidly for every additional subscriber?—Yes, when every additional subscriber wants to speak over the whole system.

That is to say, supposing you get a system as in London, where every one of the 10,000 subscribers is put into communication with each other, the more additional subscribers you get the greater is the cost?—There comes into the question whether you provide the maximum facility only.

Let us get it quite distinct. I suppose one of your objections to the present system in London is that every subscriber is put in direct communication with the rest of the subscribers, and that gives facilities which are not wanted, and facilities never made use of by certain classes of the community. You think the service ought to be made more local, so that people might communicate with their tradesmen. As I understand under the present system supposing any large increase in the number of subscribers took place the cost of working would be very much increased. Is that so?—I do not think it would be more than a very small amount.

Was not evidence given before the Committee in 1895 to that effect?—It was.

On behalf of the National Telephone Company?—Yes.

I would like your experience on that point.—My experience of the working of large telephone exchanges is not sufficient to enable me to give an answer.

What I want to get out of you is this. You are an advocate of a cheap telephonic system. Will you give an explanation as to how that is to be carried out?—In London by having regional telephony, and by the Post Office taking it over. They have wayleaves and underground wires, and it seems to me to be eminently a case in which, for the future of London, the Post Office should take it over.

Continuing, WITNESS said he did not think if the London County Council worked a rival system they would gain much by competing with the National Telephone Company on the present lines, but there was the want he had mentioned which the company had never met. He did not see why Marylebone or Kensington should not have their own local telephone services. He advocated a cheaper telephone service for a local area, and if anyone wanted to communicate at a distance, they would have to have a separate telephone and separate wires, which should be of such a quality as to be passed by the Post Office.

Would it not be a disadvantage to have two services?—That disadvantage, whatever it is worth, has forced itself upon the practice of the country.

Do you distinctly recommend to the Committee that there should be two services; one set of subscribers to communicate only with the subscribers in a local area, and the other able to send messages to different parts of the kingdom?—Most distinctly.

But you recommend that on the ground that in the first place, by limiting it to a locality, you get it cheaper?—Localities who want to have services of their own might have a system constructed in a cheap way. If they required to speak outside their own area they must have a metallic return and a first-class instrument, such as is necessary to speak over the trunk wires.

Mr. BARTLEY: Would there not be an obvious objection to such a local system where the areas are close together? How would Islington communicate with St. Pancras?—I said that London must always have a metallic return.

The CHAIRMAN: We will take it that it will not apply to London, and we will take Glasgow. What is the best way to cheapen the telephone system in Glasgow?—The first thing would be to put up an entirely new system, which would not cost as much as the present one.

How would you do that?—I have not got the capital cost of the telephone in any of these towns.

We assume that there are no wires in Glasgow, and we start *de novo* putting up wires in Glasgow. Assuming that there were 10,000 subscribers, how would you start to work to construct a cheap telephone service—an efficient one—not only of use locally, but to enable every subscriber to communicate with London?

WITNESS replied that he had not come prepared to answer a question like that off-hand, but he would draw up an estimate and hand it in.

The CHAIRMAN said he would like the witness to draw up an estimate of a local service and a service for trunk communication.

Mr. COHEN: Would the metallic return apply to Glasgow as well as London?—To a degree, but I do not know what the electrical disturbances are in Glasgow.

WITNESS was then questioned by the CHAIRMAN as to a telephone service for country districts, and explained a scheme he had drawn up to apply to the County of Suffolk. He proposed that there should be 29 exchanges, which would require the construction of 524 miles of new lines along the roads not already occupied with lines by the Post Office, and it would require wayleaves also for wires of 252 miles on telegraphic poles belonging to the Post Office. The total mileage of wire required would be 3,970. This provision was almost entirely for call offices, and there was an estimate that there would be a certain proportion of private connections as well. The cost of the system of 29 exchanges provided, with 50 per cent. for spare connections, would be £4,375; 351 call stations, at an average of £7 10s., £2,633; 524 miles of new line, at £20 a mile, £10,480; 3,970 miles of wire on new and existing poles, at £5 a mile, to provide double conductors with metallic returns in the case of 950 miles, £23,820; contingencies, £4,130; total, £45,435. The interest and sinking fund, at 4½ per cent., would be £933; renewal of poles, £733; renewal of wires, £238; wayleaves, £574; wayleaves on existing poles, £675; management, £300; salaries for maintenance, £1,880; rent and sundries for 351 call offices, £3,159; rent, and sundries, and salaries for 29 exchanges, £2,958; contingencies, £593; total annual outgoing, £11,973. He estimated a profit of £990 a year on private lines, further, he would make a charge of £8 a year, and calculated to make a profit of £3.

Examined as to how the person going to a call office was to communicate with the person he wished to speak to at the other end, WITNESS said that a message would have to be sent to the person that he was required at the call office. He knew that was done in Canada. He estimated to make it pay in a village of 300 people, 2s. would have to be taken per day, 309 days in the year. He thought the National Telephone Company and the Post Office should have a greater number of call offices, but he could not say whether their plant would be sufficient to carry a greater number of messages.

Sir HENRY HOWORTH: Do you think if the company was to face their regional system it would get a good return on its capital?—I think it would be wise of them to expend the capital on it.

From your experience, how do you explain the enormous capital of this company in comparison with the cost of its plant?—I think when a system of this kind is administered for the whole of a large area like the United Kingdom, owing to the lack of local interest and superintendence, it necessarily becomes more costly.

Do you think it would be more economical for the Government to start *de novo* with its own plant, or to take over the whole of the company's plant at its capital value?—I am quite certain if it is practical it would be better to construct it *de novo*, but it is difficult to imagine such a thing as wiring England again.

Supposing it is done piece-meal by local authorities, would it be economical for local bodies to start their own plant, or to buy the existing plant?—Undoubtedly they should start with a new plant.

Further examined, WITNESS said that, owing to the monopoly of the Telephone Company, there were at present few telephone engineers in the country who could carry out other systems. At present, an associated company made the plant for the Telephone Company, but if a demand was created it could be made cheaply in England. If the municipalities were to be authorised to work telephones, there would be no difficulty in their getting plant, but there were no other firms in the country at present who manufactured it. He did not contemplate that at the expiry of the license of the Telephone Company, the company would cease to exist, for that would be chaos. But if licenses were allowed to municipalities now, and they competed with the company, it would mean the survival of the fittest.

By Mr. NICOL: He did not advocate the Post Office taking over the

local exchanges, for he did not think they could work a capilliary system at a cheaper rate than a local organisation.

Mr. Stuart: Why should the Post Office not take them over in the country if they take over the system in London?

Witness explained that London could be compared with no other city in the world, and he thought that the Post Office, with its experience of laying wires, would be able to cheapen the cost.

The Select Committee resumed its sitting on Tuesday last, Mr. R. W. Hanbury presiding.

Mr. A. R. Bennett, of Harlesden, in reply to the chairman, said he was a member of the Institution of Electrical Engineers and a general consulting engineer and electrician. He was telephone engineer to the Corporation of Glasgow, and electrical engineer to the States of Guernsey, besides being a general consulting electrical engineer in London. He had had very prolonged experience in connection with telephone installations. From 1881 to 1883 he was engineer to the Commercial Telephone Exchange in Glasgow. Afterwards he was chief engineer for Scotland and Ireland to the National Telephone Company; in the following year he was promoted to be chief manager, as well as engineer to the company in Scotland, which position he held until 1890. From 1890 to 1892 he was general manager and chief engineer to the Mutual Telephone Company, and from 1892 to 1895 he occupied the same position in connection with the New Telephone Company.

Can you give us your opinion as to the possibility of providing telephone communication at lower rates, so as to bring the telephone service within the reach of other classes of the community than those enjoying it at the present moment?—I have devoted a great deal of attention to that subject, and I can testify that a good exchange connection, using the best of instruments and materials, could be constructed at a cost varying from £12 to £24 per subscriber, according to the size of the town or district to be telephoned.

This is not merely for a local service, but for a service which would be in communication with the rest of the kingdom through trunk wires?—Quite so. The difference between the cost of first class apparatus and second class is not very considerable, and I always make a point to put in the best, so that the price I have mentioned would enable subscribers to communicate all over the kingdom by means of Government trunk wires.

Is there any difference in the cost between a large town and a small one?—Yes, the capital outlay for a small or medium sized town, where one switch room suffices, is from £12 to £14 per subscriber, but in larger towns where several switch rooms connected by junction lines are required, the cost in the absence of special obstacles should range from £16 to £24 per line, excepting in London, where I estimate the cost would be £36 per line.

Will you explain why the price varies so much in these various towns, and particularly why it is so much larger in London?—In small towns the business community is generally gathered within a small area, consequently subscribers' lines are short, perhaps not exceeding on an average a quarter of a mile, whereas in larger towns the commercial people are scattered to a very much larger extent, and if they were connected with one central exchange the average length of their lines would be considerably in excess of the average length of smaller towns. In that case it is usual to construct several switch rooms, which has the effect of reducing the average length of subscribers' lines, but which requires additional lines for junction lines for connecting the various exchanges. That accounted for the difference in cost between a large provincial town and a small town. In London asphalte and wood pavements existed to a very much larger degree than was the case in provincial towns, and the cost of making good such pavements was very considerably in excess of the cost of making good either macadam or granite blocks. It was necessary, therefore, to make special allowances for London. Continuing, witness said he did not attribute the present cost of the telephone service in London to the fact that too large a number of subscribers were put into communication with each other. As he understood it at present, every subscriber was in connection with all the others, and he did not think the telephone would be of much use if the exchange was restricted to certain localities. There were instances in which that had been done, but when they looked abroad and found the very large exchanges which existed—for instance, in Berlin, where there were 29,000 subscribers—it certainly was not time, when we had only 10,000 subscribers in London, to talk about limitations.

Does the cost increase very much as the number of subscribers to exchanges increase?—No. I know it is generally said to be so, but I always considered that to be a fallacy, and I shall be able to put figures before you dealing with that very point. Mr. Provand, M.P., has recently obtained through the Foreign Office the particulars of a good many foreign telephone exchanges, which I believe he will put in to the Committee. Amongst those reports are a very valuable series from the German Government. The German Government say that in Berlin they have 28,785 exchange instruments at work, and that the capital cost per line had been £22. In Hamburg they had 13,561 exchange instruments at work, and the average capital cost has been £23. In Leipsig there are 5,289 instruments at work, and the capital cost has been £19 2s. In Franfort-on-Main there are 5,063 instruments at work, and the capital cost has been £22 18s., and at Cologne, there are 4,701 instruments at work, and the capital outlay there has averaged £19 12s. It is obvious that the cost in Berlin is not sensibly greater than the cost in Cologne, although the number of subscribers in Berlin is very nearly 17 times the number in Cologne, and that accords with my own experience.

The service in Berlin, where there are 28,000 subscribers, costs £22, as against £36 which you estimate it ought to cost in London. Why is it?—Of course, Berlin, although a very large city, is considerably smaller than London.

But why, in your opinion, does this difference of £14 arise between the two cities?—I should say that on the whole Berlin is a much easier town to telephone. It is not so scattered as London, and it does not cover nearly the same superficial area. Then, again, the pavements there are not wood or asphalte to nearly the same extent as they are in London.

Witness, continuing, said that in Switzerland, Luxemburg, Finland, Norway, Denmark, and Sweden, there were very extensive country systems.

Does it extend to the small villages of 300 or 400 population, for instance?—Yes, in some countries there is scarcely a village of that size without a telephone exchange—especially is that the case in Switzerland and Denmark.

Do you know any country where the rates vary according to the use made of the telephone?—Yes, in Switzerland and in Guernsey, where the telephone exchange is not yet opened; the States have adopted a system of charging which will enable the subscribers to pay in accordance with the use they make of the telephone. With reference to the service in Jutland, there was no Post Office monopoly, but the Danish Government was now in process of taking over as many trunk lines as it could. The Danish Government thought with our Government that the trunk lines ought to be in the hands of the Government.

If a message is sent in Jutland from a call office from a subscriber to a person who is not a subscriber, how is the message delivered at the other end?—I cannot answer that question specifically, but in Copenhagen the operators at the call office are allowed to write down a few words on a slip of paper—practically, they are allowed to write down short telegrams, and they are delivered by the post office.

Is there an extra charge for that?—Yes, of about 1d. for 10 words. Continuing, Witness said he was in favour of making the best use possible of the telephone, and he would very much like to see the telephones and the Government working more closely together. If that were done it would have a very considerable effect in increasing the usefulness of the telephone, but so far the Post Office seemed to be possessed with a desire to restrict the telephone service as much as they could.

In London at present a man pays the same subscription, whether he sends 1,000 messages a year or two. Do you think it is impossible by any system to let people pay according to the user of their private wire?—The system of paying a lump sum is one which prevails to a very large extent, but another system has prevailed in Switzerland for a good many years past. In Switzerland, a subscriber pays £4 for the first year, £2 16s. for the second year, and £1 12s. for the third, and subsequent years of his connection with the telephone exchange, and in addition to these annual payments, he is charged at the rate of 4s. per 100 calls which he makes; the man who is called is not charged anything. Consequently a subscriber who has 365 calls per year pays the annual subscription in the first instance, and then he pays another halfpenny per day for his calls, and as he is only a small user he only pays a comparatively small sum to the Government, particularly if he has been a subscriber for three years; but a man who calls five or six times a day has to pay practically 3d. a day, and so in Switzerland they make the charge dependent practically upon the user. In Guernsey they had adopted practically the same plan, but with a smaller initial charge. In Guernsey the charge was to be 30s. per annum down, and 1d. per call up to 1,000 calls per annum, and everything over 1,000 calls at the rate of five calls per 1d. If a very small user only called once every two days his total annual charge would be £2 5s. 2d.; if he calls once a day his total annual charge would be £3 0s. 5d., if he calls twice a day the total annual charge would be £4 10s. 10d., and similarly three, four, and five calls a day would bring his charge up to £5 14s. 11d., £6 1s., and £6 7s. 1d. respectively.

By Sir James Woodhouse: At present no maximum had been fixed for an unlimited user.

Replying to the chairman, the Witness said that in Switzerland the number of subscribers was very large in proportion to the population. Norway had the largest number of subscribers to the telephone in proportion to population, where there was 144 persons to each telephone. In Sweden, the numbers worked out at 147; in Luxemburg, 160; 172 for Switzerland; 211 for Denmark; 328 for Finland; Imperial Germany (post office), 449; Bavaria, 451; Wurtemburg, 459; then came the United Kingdom with 636, which was the sum of the National Telephone Company's subscribers and the Post Office subscribers. France was very low down—1,342, and in Austria the figures were 1,640 to every telephone. With regard to Guernsey he expected the exchange would be opened shortly, and about a fortnight ago there were 325 subscribers. He could not tell exactly what the capital charge would be, but the estimated cost was £13 14s. per subscriber, and they had every reason to believe that the charge would be kept within those limits. The population of Guernsey was 35,000.

So at present you have not got a very large proportion of subscribers?—325 works out at something like 180, whereas in the neighbouring island of Jersey, which is worked by the National Telephone Company, the number of subscribers is only something like 80, and the population is over 20,000 more than Guernsey. When the National Telephone Company opened in Jersey they began with a £10 rate, with limitations as to distance, but they did not get many subscribers at that rate and they soon reduced it to £8. That was in 1895, and they had about 40 subscribers in the island. Then when Guernsey showed that it wanted a telephone system and was pressing the Post Office to grant it and the Guernsey tariff was published, the National Company reduced their rates in Jersey to £6 10s. per annum without any limit of distance. The consequence of that reduction had been that they had exactly doubled the number of their subscribers. Witness then explained to the committee that the estimate he gave before the Glasgow inquiry as to the cost of establishing a telephone

service in that country was based upon estimates he had received from reliable firms. The cost of telephone material was undoubtedly falling, and there was also a likelihood of a reduction being effected in the working. There was a new automatic switch room exchange which would dispense with the services of the lady operators. He had tested the invention himself, and he thought that for exchanges up to 600 or 1,000 subscribers it was likely to answer extremely well indeed.

But you don't think it would answer for the larger exchanges?—The inventors claim that they could do it up to 5,000 or 10,000 subscribers, but they have not done it yet. At the present time, however, for exchanges up to 400 or 500 subscribers, it was actually in use in several towns in the United States. Continuing, the witness said that most of the materials used in telephony was imported from abroad. The cables were made in this country.

Replying to Sir J. WOODHOUSE, WITNESS said that the reason why the materials were not produced at home was that there was not sufficient scope to allow of manufacturers competing with firms abroad who also sold materials in their own countries. If the telephone system in England were free it would have a most important effect upon many electrical industries, and he believed that the telephone industry would be equal to the bicycle industry in importance. His estimate for Glasgow was five guineas per subscriber, which, he reckoned, would enable the Corporation to get a return upon its capital outlay; but he thought that, with careful management, local authorities throughout the country might even improve upon that amount. A local authority had no expensive board of directors to pay, and it was free from many other charges which a company would have to pay. He was decidedly of opinion that it was to the public interest that there should be competition in telephones, but he would not go so far as to say that the best competitors would be the local authorities. His idea was that local management was a very essential feature in telephones, and whether that local management came from a municipality or a local company, did not, in his opinion, affect the matter much. What was wanted was a knowledge of local requirements.

By Mr. FRY: It would be to the advantage of the public and of the electrical industry if competing services were established.

Mr. J. STUART: He did not believe the National Telephone Company could make a £5 rate pay. It could only be done in the case of an entirely new company, or by a municipality. He thought the London County Council, which had special facilities for creating a telephone service in London, would be able to give local services for £5 or £5 5s.

Mr. J. C. LAMB, C.B., second secretary to the Post Office, was recalled, and briefly examined as to the policy which the Department had pursued in relation to the extension of exchange areas to the National Telephone Company. He said that the Post Office had acceded to the requests of the National Company for new areas when they thought they were needful in the interests of the public. Mr. Forbes refused to sign the agreement of 1892 until he obtained a verbal promise from Mr. Ferguson that it would be carried out by the Post Office in a reasonable spirit, and that verbal agreement was subsequently ratified by Mr. Arnold Morley.

The Committee then adjourned.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. THOMPSON & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*

12,200. "Improvements in fittings for gas and electric pendant lamps and the like." J. MORRIS, jun. Dated May 31st.

12,201. "Improvements in quadruplex and multiplex telegraphy and to apparatus for use in connection therewith." S. G. BROWN. Dated May 31st.

12,220. "Improvements in or connected with electrically driven vehicles." C. JEANTAUD and W. C. RECHNIEWSKI. Dated May 31st.

12,232. "Improvements in tele-motor apparatus for working, steering, telegraphing, indicating, and other apparatus from a distance." A. B. BROWN. Dated May 31st.

12,237. "An improved A B C transmitter for telegraphic purposes." W. MILNER and C. C. VYLE. Dated May 31st.

12,241. "Multiplex and duplex printing telegraph." A. SILBERMANN. Dated May 31st. (*Complete.*)

12,268. "Improvements in insulating means for electric furnaces." W. L. WISE. (The Aluminium-Industrie Actiengesellschaft, Germany.) Dated May 31st.

12,313. "Improvements in secondary batteries or electric accumulators." F. KING. Dated June 1st.

12,321. "Improvements in electric batteries." E. EDWARDS. (P. A. Emanuel, United States.) Dated June 1st. (*Complete.*)

12,322. "Improvements in electric batteries." E. EDWARDS. (P. A. Emanuel, United States.) Dated June 1st. (*Complete.*)

12,323. "Improvements in electric batteries." E. EDWARDS. (P. A. Emanuel, United States.) Dated June 1st. (*Complete.*)

12,325. "Improvements in apparatus employed in wireless telegraphy." G. MARCONI. Dated June 1st.

12,326. "Improvements in apparatus employed in wireless telegraphy." G. MARCONI. Dated June 1st.

12,347. "Improvements in electric railways or tramways." J. J. STEINBACH. Dated June 1st.

12,349. "Improvements in microphones." SIEMENS BROTHERS AND CO, LIMITED. (Siemens and Halske, Gesellschaft, Germany. Dated June 1st. (*Complete.*)

12,350. "Improvements in electric alarums." SIEMENS BROTHERS AND CO., LIMITED, and J. EBEL. Dated June 1st. (*Complete.*)

12,351. "Improvements in portable telegraphic apparatus." SIEMENS BROTHERS & CO., LIMITED. Dated June 1st. (*Complete.*)

12,354. "Improvements in microphones." J. BERLINER. Dated June 1st.

12,365. "Improvements in portable electric lamps for use in mines and other places." S. F. WALKER. Dated June 2nd.

12,423. "Improvements in electric switches." A. VANDAM and T. H. MARSH. Dated June 2nd.

12,431. "Improvements in apparatus for the production of electricity in railway carriages and other vehicles." E. J. PRESTON. (The Gould Coupler Company, United States.) Dated June 2nd.

12,437. "Improvements in or relating to electric arc lamps." C. OLIVER. Dated June 2nd.

12,438. "Apparatus for indicating leakages or escapes of current from electric conductors." M. KALLMANN. Dated June 2nd.

12,446. "A new or improved hub for generating electricity for use with velocipedes and other vehicles." J. E. PRESTON and B. WHARTON. Dated June 3rd.

12,461. "Improvements in, and in relation to fenders for electrical and other tramcars, motor cars, and such like vehicles." J. W. TOWLE. Dated June 3rd.

12,471. "Improvements in electrically-propelled motor cars." L. COUDAT. Dated June 3rd.

12,562. "Improvements in or relating to electric motors and the transmission of power therefrom." FAWCETT, PRESTON & Co., LTD, and C. A. MATTHEY. Dated June 4th.

12,580. "Improvements in the manufacture of conduits for electric cables or conductors, and in the method of securing the said cables or conductors therein." F. CHIESMAN and S. CHIESMAN. Dated June 4th.

12,604. "Lunaria electric cycle and carriage lamp." S. G. HAMILTON. Dated June 4th.

12,606. "Improvements in electrical firing keys." C. A. MCEVOY. Dated June 4th.

12,511. "Improvements in or relating to incandescent electric lamps." O. RIEBENSAHM, J. PLEICHATI, H. FRIEDEBERG, and E. KRUGER. Dated June 3rd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free,* 9*d.*, *(in stamps).*

1897.

996. "Improvements in and relating to accumulator plates." W. MAJERT. Dated January 13th, 1897. This relates to accumulator plates for high current density and capacity. This is produced by increasing the surface, which is effected by dividing up the lead core plate on both surfaces into thin strips which are formed by a suitable tool into vertical ribs. The tool has a surface situated behind its cutting edge which bends the strip that has been divided from the plate into a rib. 3 claims.

8,280. "Improvements in and relating to electro-medical apparatus and brushes for use therewith." C. KLEIN. Dated March 31st, 1897. The object of this invention is to enable a current of requisite strength to be applied to the body. In this apparatus there is a pivoted contact piece operated by a rod sliding in a guide and fastened to a movable core in an induction coil. This core carries a pointer which give indications upon a graduating strip. There is a screwed rod located in position in its support, one end of which engages with the commutator spring. In brushes there is a metallic support carrying a flexible plate upon which metallic bristles are so arranged as to make contact with the plate, when pressure is applied; this plate having a conducting wire attached and situated in a suitable part of the brush. 3 claims.

17,691. "Improvements in electrical conduits." H. L. DOULTON and C. E. MORRIS. Dated July 28th, 1897. This relates to jointing butt lengths of earthenware conduits and making branch connections with the conductors in them. Metal collars are used to secure mechanical strength. Each collar is in two parts, which embrace the adjoining lengths of conduit, and are provided with lugs and clamped together by bolts. A space is left between the two pieces of the collar to allow for variation in the size of the conduit. This space is covered on the outer side by flanges. In making branch connections with the conductors within longitudinally divided lengths of conduit are used. Slots are provided for the passage of the branch cables and there is connecting piece which fits in the outer slot, the end of which is provided with a socket. Another method of making a branch connection is to substitute an iron box for a length of conduit. The box is divided, and the two portions secured by bolts, at each end is an interior annular cavity. It is provided with openings for branch cables. 6 claims.